

LACIE-T00201

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)

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USDA LACIE PROJECT OFFICE
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U.S. DEPARTMENT OF AGRICULTURE

LARGE AREA CROP INVENTORY EXPERIMENT
(LACIE).

USER REQUIREMENTS

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E-R-R-A-T-A

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NOTE: Publications or documents referred to
in this publication may be obtained
from the LACIE Project Office or USDA origi-
nating agency.

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1.1 INTRODUCTION

The launch of an Earth Resources Technology Satellite (ERTS) in 1972, and the results of subsequent experiments utilizing various remote sensing techniques including the digital analysis of multi-spectral data collected by ERTS, indicated that applications supporting the U.S. Department of Agriculture (USDA) information needs in the area of crop production reporting were feasible.

Based on these results, the USDA established a close working relationship with the National Aeronautics and Space Administration (NASA) for purposes of exploiting ERTS technology. As a result of this relationship, an application designated as the Large Area Crop Inventory Experiment (LACIE) was specified. Subsequently, an agreement was made between USDA, NASA, and the National Oceanic and Atmospheric Administration (NOAA), which delineates the responsibilities of each agency in conducting the experiment. Under the agreement, USDA is responsible for providing USDA LACIE requirements. This document provides those requirements.

1.2 PURPOSE

This document, prepared by the USDA LACIE Project Office, is written to provide:

- a. USDA information requirements to be supported and evaluated throughout the LACIE and serve as a basis for mutual understanding between USDA, NASA, and NOAA.
- b. Information on performance requirements, conceptual systems design and related USDA requirements, for information processing.
- c. A basis for the development of LACIE system evaluations and tests.
- d. Initial criteria for the analysis of costs and benefits to be derived from the experiment.
- e. Constraints imposed upon USDA for various legal, technical, or economic reasons.

1.3 PROJECT REFERENCES

USDA is participating in LACIE under the authority granted by the Act of August 28, 1954 (7U.S.C. 1761) and the Act of March 4, 1909, as amended by the Act of March 4, 1917 (7U.S.C. 411a), which provide for the collection of worldwide supply and production data and the publishing of monthly crop reports of domestic crop production.

On October 10, 1974, a Memorandum of Understanding among the USDA, NASA, and NOAA became effective.

1.4 SCOPE

The USDA requirements presented in this document are primarily concerned with the USDA processes involved in the preparation of wheat crop estimates on a worldwide basis. However, as appropriate, USDA information requirements are also discussed which offer high potential return but are outside the wheat crop area.

1.5 ORGANIZATION

The USDA LACIE Requirements Document is organized into five sections. Section 1, Introduction. Section 2, Functional Requirements, which contains LACIE background, objectives, and a discussion of the current crop reporting procedures and information requirements. Section 3, Detailed Requirements, presents specific data and performance requirements to be satisfied by the LACIE. Section 4, Information Handling Requirements, discusses the existing and future USDA operating environment in which the LACIE system may eventually operate, and presents the USDA systems design concept for an operational crop reporting system. Section 5, Cost Factors, which addresses the cost criteria to be used by USDA in analyzing the costs and benefits of LACIE is not included in this document. Specific cost criteria will be developed at a later date and be published as an addendum to this document.

2.1 BACKGROUND

In 1969, the southern corn blight epidemic highlighted the need for a capability to rapidly detect and assess crop conditions and thereby permit timely treatment of this crop disease. During the 1970 corn crop season, the USDA, NASA, and the academic community cooperatively attempted to monitor the spread of the corn blight using remote sensing techniques. The results of this effort indicated a potential existed for obtaining accurate and timely information on crop conditions through the use of remote sensing and related data processing techniques.

In 1972, the Agricultural Stabilization and Conservation Service (ASCS), in an effort to meet its responsibilities of insuring farmer compliance in a more timely and efficient manner, created a remote sensing user requirement task team. Their purpose was to define and quantify those ASCS information requirements which could be satisfied through the use of remote sensing. Subsequently, the ASCS task team was merged with the USDA Remote Sensing User Requirement Task Force, authorized under Secretary's Memorandum 1822. This Task Force has conducted a survey of the USDA, and has identified approximately 3,000 user information requirements for earth resource data in both foreign and domestic areas.

In July of 1972, the NASA launched the Earth Resources Technology Satellite (ERTS)*. In 1973, USDA entered into two cooperative agreements to study the feasibility of crop identification using LANDSAT data. These study efforts, designated as the Joint US/Canada Spring Wheat Feasibility Study and the Joint USDA/NASA Crop Identification Study, involved investigations into the feasibility of locating, identifying and measuring agricultural crops using LANDSAT data. The Canadian Study concentrated on spring wheat and investigated the potential for making production estimates using meteorological, climatological, and historical crop data, whereas the NASA effort concentrated on the identification of diverse crops. Each study placed major emphasis on the use of computer processing techniques for crop classification, which is the ability to distinguish between various crops being grown in the same area. The results of these efforts established the potential of using LANDSAT data for the identification and measurement of wheat, and possibly other crops.

The current world food shortages and fuel and energy scarcity with their negative impact on food supply has focused worldwide attention on the U.S. in its role as the major exporter of

* ERTS was renamed LANDSAT in January 1975 by NASA.

agricultural commodities and has created a greater need for more accurate and timely knowledge of current and projected world crop production. This information is needed in planning programs affecting crop production and the disposition of that crop. For example, price support programs can cost the government and the farmer substantial amounts of money and must be administered using current data. Exports to other countries, possibly involving millions of tons of grain, could be more effectively planned with less disruption to domestic markets if world crop production could be reliably estimated in advance on a continuing basis.

The Large Area Crop Inventory Experiment (LACIE) is designed to test a system which utilizes advanced remote sensing technology and computer processing of the data collected to provide up-to-date wheat production estimates required by various agencies within the USDA and by the public for effective decision making.

2.2 OBJECTIVES

2.2.1

Primary Objectives

The primary objectives of the LACIE are:

- a. to demonstrate an economically important application of repetitive multispectral remote sensing from space.
- b. to test the capability of LANDSAT, together with climatological, meteorological, and conventional data sources, to estimate the production of an important crop.
- c. to validate technology which could begin to provide timely estimates of wheat crop production in the 1977-78 time frame.

2.2.2

Secondary Objectives

The secondary objectives of the LACIE are technical in nature and are concerned with the design, development, and management of a demonstration experiment.

- a. to provide from an analysis of LANDSAT data acquired over a sample of the potential crop-producing area in major wheat-growing regions, estimates of the area planted in wheat; and from an analysis of historical and real-time meteorological data over the same areas, provide estimates of wheat yields and combine these area and yield estimates into a wheat production estimate.
- b. to provide data processing and LANDSAT data delivery techniques so that the selected sample areas can be available for exploitation by LACIE analysts no later than 14 days after acquisition by LANDSAT.
- c. to provide a LACIE system design that will implement an operational system within the USDA environment.

2.2.3

Phasing Objectives

The LACIE, as currently planned, will be conducted in three phases. The first phase, from November 1974 to December 1975, will evaluate the ability of LANDSAT as a data source for locating, classifying and measuring wheat acreage in the U.S. and possibly Canada. Also during this phase, research development and feasibility test of a wheat yield model using meteorological and related data sources will be conducted. A brief evaluation period will conclude Phase I.

Phase II will encompass a period from October 1975 through June 1977 and will involve an integrated operational test of the classification and measuring system and the wheat yield models developed. Phase II will concentrate on wheat production in the U.S. and Canada. Throughout the major portion of Phase II, a continuous evaluation of LACIE will be made and will serve as a basis for a USDA decision to continue development of LACIE.

Phase III, from October 1976 to June 1978, will be an operational test of the LACIE for determining wheat production in selected other countries. Sample selection, data collection and yield model development for other countries will begin early in the LACIE so that problems attendant to Phase III can be addressed before the operational test.

2.2.4

USDA Objectives

Underlying the LACIE objectives are specific USDA objectives which will serve as a basis for evaluating the success of the experiment. The USDA objectives are:

2.2.4.1

User Requirements

USDA will be the ultimate user of a successful LACIE system. Therefore, a major objective of the USDA LACIE Project Office is the preparation of a comprehensive statement of user requirements which reflect the information needs of USDA user agencies as they relate to the area, yield, and production of wheat crops. These user requirements will serve as a basis for evaluating the LACIE. This document presents those current user information requirements for wheat area, yield, and production. As the LACIE project progresses, it can be expected that these requirements will be more clearly defined and additional requirements identified; therefore, flexibility will be a major USDA requirement throughout the duration of the experiment. Changes, including modifications, deletions, or additions to these initial requirements, will be prepared and published by the USDA LACIE Project Office as addenda to this document.

2.2.4.2

Data Base Development

Another major USDA objective is to provide accurate ground truth data, where available; historical production data; and statistical sampling information for input to the LACIE systems development effort. This information will eventually serve as a major data base for an operational LACIE system.

2.2.4.3

Cost/Benefit Analysis

Critical to the evaluation of the LACIE will be its costs and benefits derived. It is a USDA objective to provide criteria and procedures for analyzing the costs and benefits of LACIE in terms of USDA user requirements.

2.2.4.4

System Design

The LACIE represents the initial steps toward the design of a LACIE-like system that may eventually operate within a USDA environment. To accomplish this objective, USDA will actively participate in the development of system design concepts and eventually the development of an operational system.

2.2.4.5

System Transferability .

Success of the LACIE as an experiment will be, in part, determined by the ability of NASA and NOAA developed systems to be transferred into the USDA environment. In order for these systems to satisfy this USDA objective, they must be modular and meet those detailed requirements presented in Section 4.

2.3 USDA USER REQUIREMENTS

User requirements can be defined as that information required by USDA agencies to perform their functional responsibilities of providing information to other government agencies and the general public. These information requirements can be further reduced to specific elements of information which, when merged together, can provide the basis for a report or a significant decision.

2.3.1

Existing Methods and Procedures

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2.3.1.1

USDA Organization

This portion of the users' requirements document presents a discussion of the current methods and procedures used by various USDA agencies to report on wheat production, both inside and outside the United States. However, before going directly into specific user information needs, it is essential that the reader have an understanding of the organization of the Department of Agriculture and those agencies requiring information on wheat production. Figure 2-1 illustrates the current organizational structure of the Department.

Department agencies that make extensive use of information about domestic and foreign wheat acreage, yield, and production include: Foreign Agricultural Service (FAS), Economic Research Service (ERS), Agricultural Stabilization and Conservation Service (ASCS), and Statistical Reporting Service, (SRS).

2.3.1.2

Foreign Agricultural Service (FAS)

FAS is an export promotion and service agency for U.S. agriculture. It is responsible for maintaining and expanding agricultural

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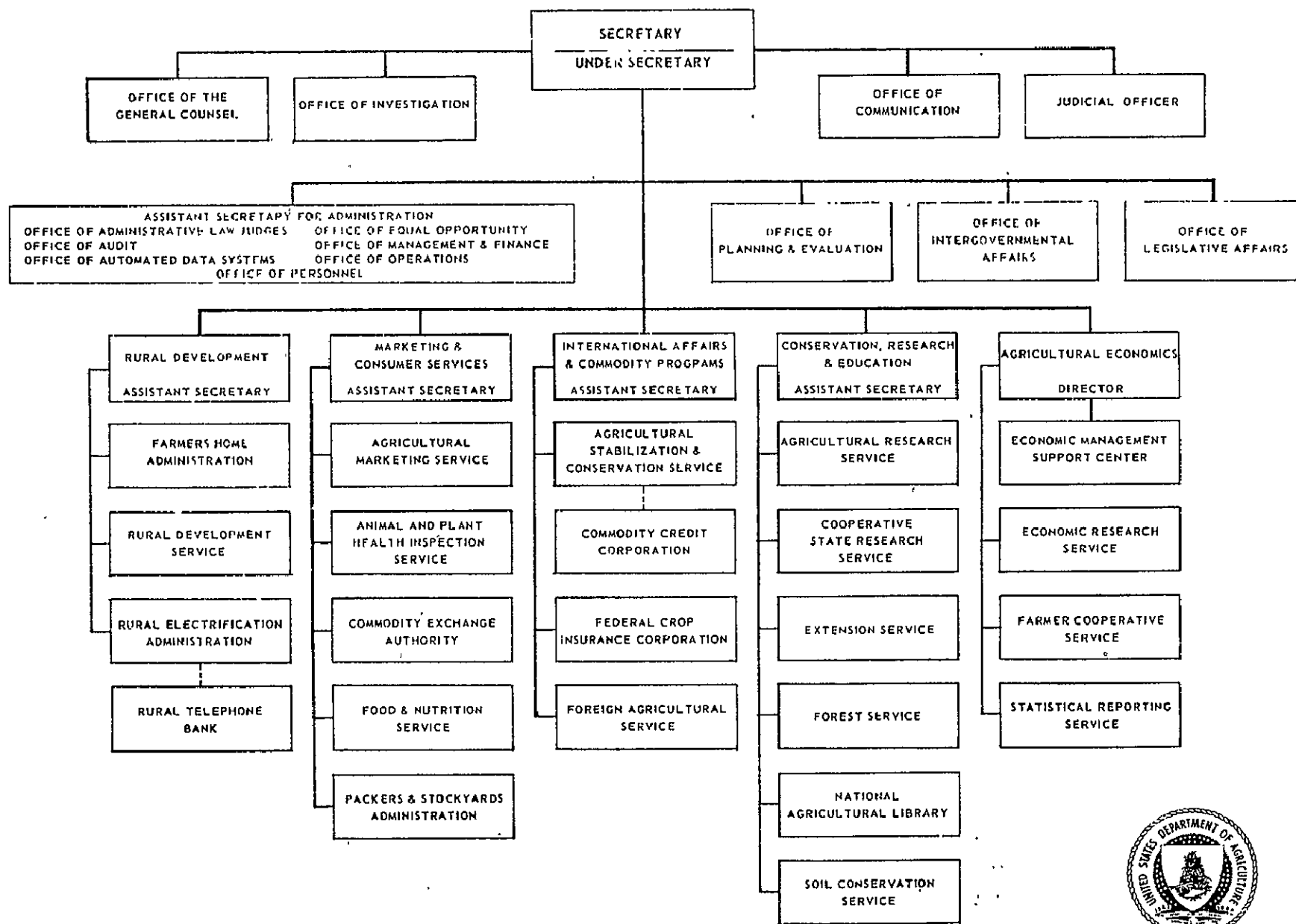


Figure 2-1



exports by cooperating with private business on jointly financed market development projects abroad; by appraising overseas marketing opportunities and communicating them to the U.S. agricultural trade; and by encouraging and cooperating with State and regional groups involved in export promotion.

To accomplish this responsibility, FAS operates and maintains a global reporting and analysis network which monitors world agricultural production, trade, competition, and policy situations affecting U.S. agriculture. This is made possible through FAS's agricultural attaches and officers stationed at approximately 60 locations covering more than 100 countries and through specialists who conduct special surveys abroad. Current information covering all principal farm commodities moving in world trade is made available through FAS publications to U.S. farm, consumer and business interests.

FAS is also responsible for conducting foreign commodity and competition analysis on worldwide production, trade, marketing, prices, consumption, and other factors affecting U.S. exports and imports of agricultural commodities. This analysis is crucial to the development of foreign market plans and programs, the provision of information to domestic producers, agricultural trade, the public and other interests, for use in establishing export and import controls, and in advising on international trade agreements.

2.3.1.3

Economic Research Service (ERS)

The Economic Research Service is responsible for conducting research programs in agricultural economics and marketing in both the domestic and foreign commerce areas. Of particular interest to LACIE is ERS research into factors affecting U.S. agricultural trade. This includes research on the total food and agricultural situation by countries and regions and examination of specific commodity developments. Studies are conducted on the long range outlook for U.S. agricultural exports. Trends in supply and demand throughout the world are analyzed together with their implications for resource adjustment and agricultural policy in the United States. Monthly, quarterly, annual, and special agricultural trade reports are prepared and published by ERS.

2.3.1.4

Agricultural Stabilization and Conservation Service (ASCS)

ASCS is responsible for administration of specified commodity and related land use programs designed for voluntary production adjustment, resource protection, and price, market, and farm income stabilization.

In each state, operations are supervised by a State committee of three to five members, who are appointed by the Secretary of Agriculture. Administration of ASCS programs at the county level is accomplished by a county committee of three farmers.

ASCS administers commodity stabilization programs for wheat, corn, cotton, peanuts, rice, tobacco, milk, wool, mohair, tung nuts, barley, oats, grain sorghum, rye, flaxseed, soybeans, dry edible beans, honey, and crude pine gum.

Commodity stabilization is achieved, singularly or in combination, through loans, purchases, and payments at announced levels. Present legislation is designed to make some export commodities more competitive in world markets. At the same time, farmers' incomes are protected by deficiency payments for wheat, feed grains, and cotton, when and if required by existing legislation.

In order to administer commodity stabilization programs and formulate commodity policy, ASCS requires information on agricultural production in the U.S. and in foreign countries.

2.3.1.5

Statistical Reporting Service (SRS)

The Statistical Reporting Service is responsible for the preparation of estimates of production, supply, price and other aspects of U.S. agricultural production. These estimates include statistics on field crops, fruits and vegetables, livestock and poultry. Within the U.S., SRS conducts enumerative and objective measurement surveys, from which statistical estimates are developed and also provides technical consultation and support for U.S. techniques in foreign countries.

2.4 CROP PRODUCTION ESTIMATES

2.4.1

Requirement

The USDA is required, by law, to collect information on the production and supply of crops on a worldwide basis, and to publish crop reports of domestic and foreign crop production. This requirement currently extends to the collection, maintenance, analysis, and reporting of estimates of future crop production as well as the reporting of actual production. Each of the USDA agencies discussed above is involved in some aspect of these processes of collection, maintenance, analysis, and scheduled reporting of crop production information.

2.4.2

Existing System (Foreign)

2.4.2.1

Foreign Agricultural Service (FAS)

Foreign crop production estimates are prepared and published quarterly by the Foreign Agricultural Service. The Grain and Feed Division within the Foreign Commodity Analysis Office has primary responsibility for preparing production estimates of wheat and other grain crops for all major crop producing countries. Commodity analysts in this office receive information on crops from several sources. These sources include: Agricultural Attaches located in foreign countries, foreign publications, commodity periodicals of the country, Reuters commodity reports, the commodity trade, foreign newspapers and the wire services. Information provided by these sources serve as the basis upon which the commodity analyst in Washington develops crop production estimates. These analysts depend primarily on the Attaches scheduled reports, usually prepared quarterly, which are developed from information Attaches obtain from foreign government and trade contacts. Additionally, analysis is based upon an Attache's own observations, information from grain importers, grain processors, farm organizations, and various published reports available to an Attache in his countries of assignment.

The FAS commodity analysts, using information obtained through the Attache and other sources, prepares and maintains estimates of crop production for all major commodities of interest to USDA.

Also critical to the collecting and reporting of estimates of crop production, FAS analysts, in conjunction with ERS and ASCS specialists, prepare estimates of the total world grain supply and distribution activity, which includes: world trade (exports and imports), consumption, and stocks available. This information is then combined with production estimates and published quarterly in a Foreign Agriculture Circular entitled, World Grain Situation: Review and Outlook. Appendix B contains one of these reports. Information contained in these reports is subsequently used by the Foreign Market Development Office of FAS to recommend U.S. trade activities. This function will be discussed in detail later in this report.

Commodity analysts in the Grain and Feed Division of FAS are action oriented and concerned with keeping abreast of the world grain situation concerning the current crop year. They continually monitor incoming information which may effect changes in their crop production estimates. This action oriented situation is primarily due to the current world food situation, and these commodity analysts

are often required to quickly respond to numerous ad hoc requests from upper level USDA management concerning foreign production, existing supplies, and/or disaster conditions.

2.4.2.2

Economic Research Service (ERS)

In contrast to the FAS requirement for preparing current crop production estimates, the Foreign Demand and Competition Division of the Economic Research Service prepares reports which analyze the long-term effects of changes in crop production and the economic implications of these changes on regional and world trade, as well as assessments of the short-run outlook for supply and demand. Another distinction to be made between FAS and ERS is that FAS commodity analysts, with a few exceptions, are concerned with commodities, whereas ERS has both commodity analysts and country analysts. ERS analysts are concerned with the collection, maintenance, analysis and reporting of information about a country's total agricultural output and its effect on the world economic situation. ERS analysts are more concerned with the development and analysis of data which depict longer term trends in agricultural production of a country or region rather than current reporting. One exception to this is in those foreign areas or countries where no Agricultural Attache is assigned. In this situation, ERS has primary responsibility for developing estimates for FAS. Usually these areas are studied by a joint ERS/FAS task force which then prepares reports. ERS analysts are more research oriented and analyze other factors which may effect changes in a country's agricultural output, such as increased use of fertilizer, irrigation, technology, cultural practices or other changes in cropping practices.

The collection, analysis and preparation of crop production reports by ERS is accomplished using much of the same information used by the FAS commodity analysts. All incoming FAS Attache reports and related information is received in FAS and distributed to the ERS analysts. In addition, these analysts receive periodicals and newspapers directly from their countries of interest. All of this information is then analyzed and used to develop crop production estimates. To assist the analyst in making estimates and in analyzing trends, the country analysts maintain reference files of documents concerning agriculture in the country or countries of interest. Using these reference files and the incoming information, country analysts study trends in country production, prepare reports and articles for periodicals, update and maintain current estimates, and prepare scheduled reports. An example of this type of analytical study accomplished by the Foreign Demand and Competition country analysts is the quarterly World Agricultural Situation Report and regional supplements.

2.4.2.3

Data Analysis

The information received by FAS and ERS analysts is reviewed and assembled into estimates for their respective agencies. If new information is received which indicates a change in an estimate should be made, an estimate change sheet is circulated in FAS and ERS. Periodically, FAS and ERS analysts meet to discuss their estimates and agree on changes based on information or analysis one or the other may have that may justify a change. Depending on the data available, a change in an existing estimate may or may not be made.

Critical factors in the preparation of crop production estimates are the timeliness, accuracy, and completeness of the information received for analysis by the FAS and ERS analysts. On many occasions, information is difficult to obtain, is of questionable reliability or arrives too late for inclusion in a quarterly report. In these cases, the analysts will make estimates based on past trends. Figure 2-2 illustrates the present Foreign Crop Estimating Process.

2.4.2.4

Constraints in the Process

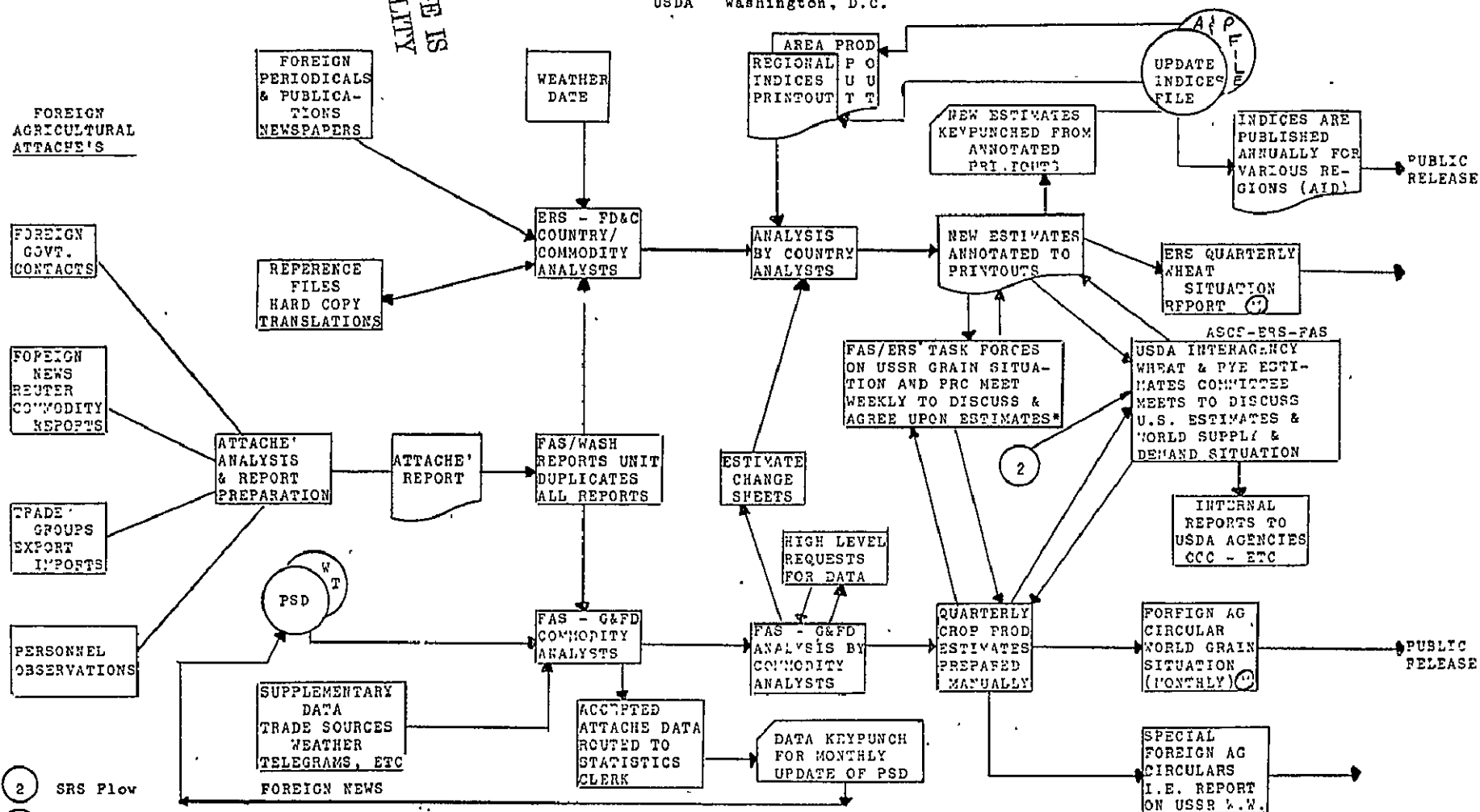
The present, essentially manual, foreign crop estimating process contains many constraints, both external and internal, which effects the currency and accuracy of reported data.

2.4.2.4.1

External Constraints

External constraints are considered those outside USDA which are unlikely to change. First, there is a general lack of current and accurate data from some of the major wheat-producing countries which represents a very significant constraint. This constraint can be attributed to: a foreign country's inability to collect and maintain accurate production records; archaic or non-existent methods and procedures for the collection and analysis of statistical data in several wheat growing countries; limited use of meteorological data by wheat producing countries when estimates are prepared. A second factor that must be considered when official foreign estimates are published, is the country's political situation which may bias the estimates for various reasons. Another constraint affecting reporting accuracy may be the country's traditional method of reporting certain crops. For example, the Soviet Union includes pulse crops in its wheat estimates.

USDA Washington, D.C.



Another significant constraint is the reluctance on the part of certain countries to provide any official data.

2.4.2.4.2

Internal Constraints

Internal constraints are considered those within the USDA environment which have a potential for improvement. A major constraint of the foreign crop estimating process is the timely receipt of information from the Agricultural Attache. Presently, the Attache reports grain and feed data on a quarterly basis. Attache reports due in FAS in August will be analyzed and the results will be published in mid to late September. Outwardly, this may not appear untimely; however, the Attache's report is due in by the 15th of August. Allowing approximately seven days for movement of the report from the foreign country to FAS/Washington means the report must be completed by the first week in August. To meet the deadline, and allow adequate time for report preparation, data collection by the attache must begin in early July and be finalized in late July. Based on these assumptions, much of the data contained in the September estimate can be based on data obtained in July. If the data was obtained from the Attache's foreign government contacts, it may be more outdated. To circumvent these delays, Attaches will send in unscheduled reports recommending revisions to their previous report or providing new data from their foreign contacts or personal observations. This data is then reviewed by the FAS commodity analyst and may result in a change to the production figures prior to publication.

Another internal constraint is the subjective approach used in the analysis of Attache data and the subsequent formulation of crop production estimates. The process is almost exclusively manual and relies on the knowledge and experience of the Washington, D.C. based FAS/ERS analysts to interpret incoming data and develop production figures. This is accomplished without necessarily having current information on crop conditions, in particular areas of a country, and using only limited meteorological information. Using this subjective analysis technique causes fluctuations in estimates and occasionally these can be significant. Table 2-1 illustrates the 1973-74 wheat estimates and percent of adjustment over time.

Another constraint of the process is the limited application of data processing by FAS and ERS. The applications which currently exist are also somewhat duplicative in both data content and function.

The FAS commodity analyst is aided in the preparation of World Grain Situation reports and in related duties through the use of two computer files. These are the Production, Supply and Distri-

TABLE 2-1
1973-1974 WHEAT ESTIMATES AND PERCENT OF ADJUSTMENT OVER TIME

DATE OF ESTIMATE	CANADA		ARGENTINA		USSR		INDIA		AUSTRALIA	
	MILLION M/T	% ^{1/} CHANGE	MILLION M/T	% ^{1/} CHANGE	MILLION M/T	% ^{1/} CHANGE	MILLION M/T	% ^{1/} CHANGE	MILLION M/T	% ^{1/} CHANGE
April 1973	18.0	---	7.0	---	75.0	---	---	---	---	---
August 1973	17.0	-5.5	6.0	-14.3	80.0	+6.2	27.5 (1st)	--	11.8 (1st)	--
October 1973	17.0	-5.5	5.4	-22.9	84.2 ^{2/}	+11.5	25.5	-6.3	13.2	+11.9
December 1973	17.1	-5.0	5.4	-22.9	88.4 ^{2/}	+16.7	24.5	-10.9	13.2	+11.9
February 1974	17.1	-5.0	5.8		91.3	+21.7	24.9	-9.5	10.9	-7.6
March 1974	17.1	-5.0	6.0	-14.3	91.1	+21.5	24.9	-9.5	11.9	+0.8
May 1974	17.1	-5.0	6.0	-14.3	91.1	+21.5				
June 1974	17.1	-5.0	6.5	-7.1	91.1	+21.5	24.9	-9.5	12.0	+1.7
August 1974	17.1	-5.0	6.7	-4.3	91.1	+21.5	24.9	-9.5	12.0	+1.7
September 1974	16.5	-8.3	6.7	-4.3	91.1	+21.5	24.9	-9.5	12.0	+1.7
November 1974	16.5	-8.3	6.7	-4.3	91.1	+21.5	24.9	-9.5	12.0	+1.7
December 1974	16.5	-8.3	6.6	-5.7	91.1	+21.5	24.7	-10.2	12.1	+2.5

^{1/} Percent change from initial 1973 projection.

^{2/} FAS now publishes USSR production estimates on a gross instead of net basis. USSR gross production estimates for October 1973 through December 1974 were converted to net production for purposes of comparison with earlier estimates

bution (PSD) file and the World Trade (WT) file. The PSD file contains historical data on area (planted and harvested), production, imports, exports, stocks and use. The World Trade file contains information concerning stocks, exports, and prices.

The PSD files currently contains approximately 14 years of data and is basically structured by:

- | | | | | |
|--------------|---------|---------------|------------|------------|
| 1. Commodity | 3. Data | 5. Production | 7. Imports | 9. Use |
| 2. Country | 4. Area | 6. Stocks | 8. Exports | 10. Yield* |

The PSD is primarily used as an information storage and retrieval file to aid the analyst in maintaining large amounts of data readily available for reference and to assist him in preparing reports.

The World Trade file does not contain production data and is not discussed here as it is not directly concerned with the foreign crop estimating process.

The Foreign Demand and Competition Division of ERS also maintains two computer files which are used to aid ERS country analysts in their analysis and report preparation. These files are called the Area and Production Data Base and the Indices of Agricultural Production file.

The Area and Production Data Base, sometimes referred to as the Grain Data Base, contains historical data on estimates of agricultural production. It is called the Grain Data Base because it currently contains data only on grain crops grown throughout the world. This data file is structured by the following data elements:

- | | | | | |
|------------|--------------|---------|---------|---------------|
| 1. Country | 2. Commodity | 3. Date | 4. Area | 5. Production |
|------------|--------------|---------|---------|---------------|

Yield is displayed on printouts from this file and is computed from area and production.

This file also contains references to the source of reported area and production figures, as well as the native unit of measure and the conversion factors used to convert to metric units. The file contains historical data from 1950 to the present for all countries of the world except Africa, which is included from 1960 to the present.

The Area and Production Data Base is basically an historical information storage and retrieval file which aids the country analyst in maintaining a current record of a given country's area and production for a specific crop. Further details on this file are discussed in Section 3.

* Yield data is not input to the PSD but is computed from area and production.

The second ERS file, Indices of Agricultural Production, contains historical information on the total agricultural production of a country. The indices contained in this file are computed using the total production of a commodity and the Laspeyre's base-weighted aggregative formula. The 1961-65 average price received by farmers is the weighted base figure which is expressed in U.S. dollars per metric ton. Using country production estimates, regional estimates are computed. This file is indirectly related to the foreign crop estimating process; however, it is mentioned here because it is one of the few computer applications which is actually used to publish reports.

2.4.2.5

Conclusions

a. The major constraints within the foreign crop estimating process are: (1) the quality of the data received for analysis; and (2) the time required to collect, receive, review and report; and (3) the limited application of data processing in support of the crop estimating process.

b. The existing system for the collection, maintenance, analysis and estimating of foreign crop production is essentially a manual process. Existing computer applications support FAS and ERS analysts in crop estimating reflect, to a degree, the data timeliness and accuracy constraints embodied within the process. The composite data resident in these batch processed files overlaps in many areas and is of value only in assessing trends and in reducing the amount of clerical effort associated with the preparation of scheduled reports. These file applications are of limited value in supporting current crop projections because the data contained in them is primarily historical.

c. The present system for the collection, maintenance, analysis, and estimating of foreign crop production estimates could be improved significantly through the application of more advanced data processing techniques and the exploitation of advanced data gathering systems such as LANDSAT.

d. To improve data processing techniques will require the development of an integrated crop production information system. In conducting the LACIE, an integrated data base of crop information will be required to provide remote sensing analysts with pertinent ancillary data (historical production, climate, crop calendars, ground truth) from which they can make rational analytical judgments about the data obtained from the remote sensing platform. It is only

logical, then, that the design of this data base include existing USDA data requirements as a basis for design. The conceptual design of a system to support both an operational test of the LACIE requirements and future USDA operational needs with an operational LACIE-type system is discussed in more detail in Section 4.

2.4.3

Existing System (Domestic)

2.4.3.1

Statistical Reporting Service (SRS)

SRS is the responsible agency within USDA for the collection, maintenance, analysis, and reporting of crop production estimates within the United States. By regulation, SRS is required to prepare and issue official State and National estimates and reports of the USDA relating to crop production, livestock and livestock products, stocks of agricultural commodities, local market prices, value of farm products, and other subjects as required. Crop reports prepared by SRS include estimates of acreages farmers intend to plant, acres planted and harvested, production, disposition of the crops, and crop stock levels, both on and off the farm.

The preparation of crop production estimates by SRS requires that various types of information be collected and analyzed. This information is usually collected at the State level through the SRS State Statistical Office using a variety of methods including both nonprobability and probability surveys, field observations, and personal interviews.

Nonprobability surveys are currently limited to mail surveys, where questionnaires are sent out to farmers asking for specific information about his agricultural activities. Today, mail surveys supplement probability surveys and aid the SRS statisticians in planning and executing their probability surveys.

Probability surveys, first initiated by SRS in 1954, included both enumerative surveys and objective yield surveys. Probability sampling techniques used by SRS include the area frame, list frame, and multiple frame samples depending on the type of crop or other agricultural product being surveyed.

2.4.3.2

Data Analysis

The major portion of SRS data collection takes place at the State level. State statistical offices conduct surveys, collecting the crop information via mail, telephone, personal interviews, or by various other methods. The data is then processed by the State office, reviewed, summarized, and forwarded to Washington, D.C. The summarized data is received by the Survey Division of SRS for further processing and distribution to the appropriate office within the Estimates Division. Data concerning wheat and other grain crops is forwarded to the Grain and Hay Section of the Crops Branch. This section reviews and assembles the data received from the States and prepares the official USDA estimates. If the incoming State information concerns a commodity defined by law as speculative, the information is handled according to special security procedures and is turned over to the Crop Reporting Board on a scheduled crop report day. The Crop Reporting Board, consisting of a chairman, other appointed members selected for their specialized knowledge of a particular crop, and individuals from the field and Washington, D.C., staffs, analyzes the data from the States and prepares the official estimate of production. This crop reporting process takes place in what is termed a "lock-up," wherein the Crop Reporting Board and other support personnel are restricted from outside contact until the crop report has been released. Figure 2-3 illustrates the U.S. Crop Reporting Process as it exists today.

2.4.3.3

Constraints in the Process

The SRS crop reporting estimates are accurate, reliable, and impartial when compared to those in most foreign countries. Based on these SRS estimates, decisions are made each year, by farmers, businessmen, and the Government which can involve billions of dollars. Constraints existing in the SRS crop reporting process present less of a problem than those within the USDA foreign crop estimating processes. However, the 1973-74 crop situation, caused by excessive wet conditions at planting time and severe drought during the summer, demonstrates the impact of abnormal weather events on crop estimates. More frequent yield surveys would provide current forecasts showing effects of abnormal occurrences on a more timely basis.

The 1973-74 drought illustrated that SRS requires timely, accurate, and continuous data to improve crop estimates. This improvement in data must be made at less cost and provide equal or better precision than today. Table 2-2 illustrates U.S. wheat crop estimates

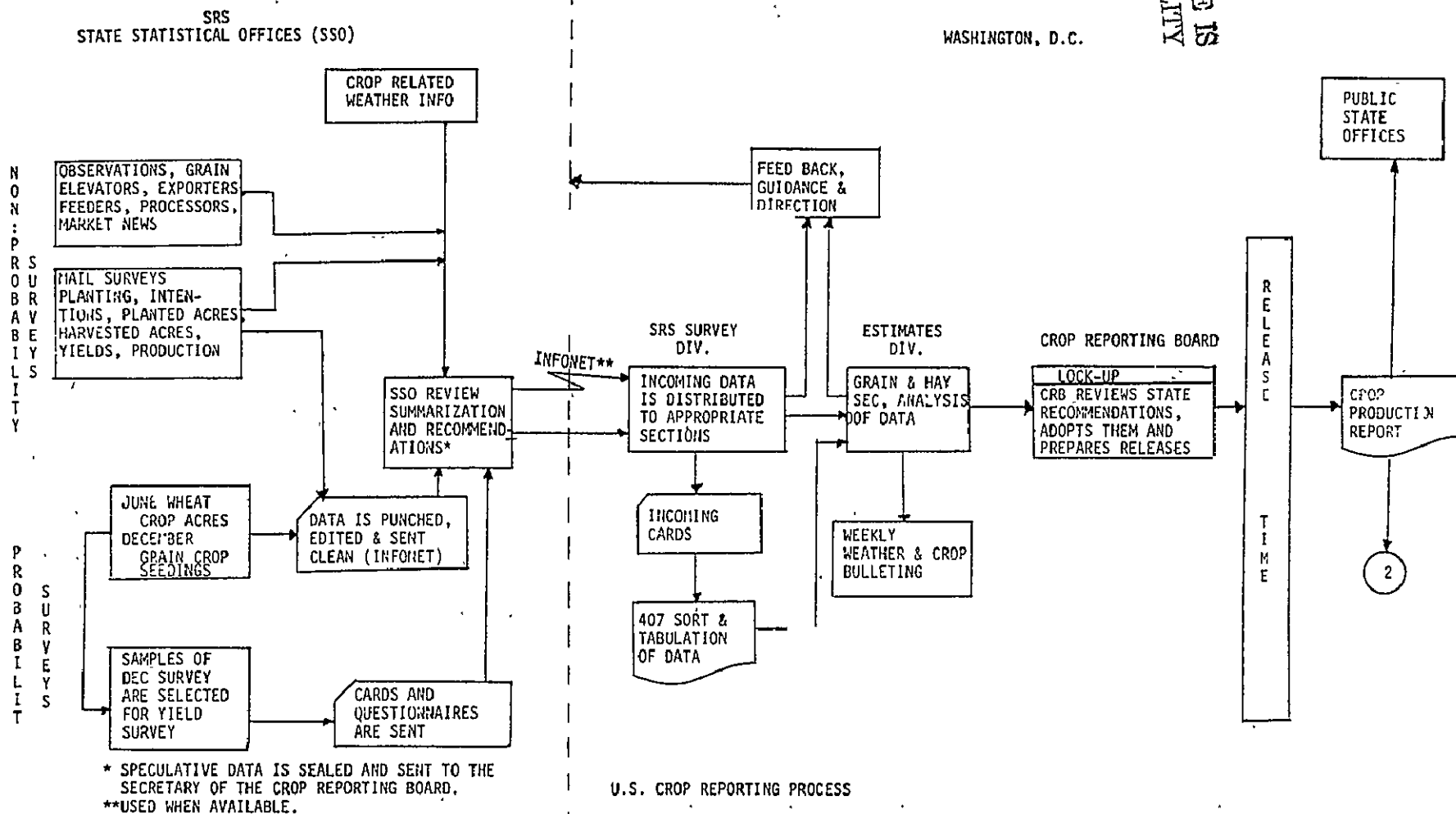


FIGURE 2-3

1974 U. S. WHEAT CROP ESTIMATES AND PERCENT ADJUSTMENT OVER TIME

TABLE 2-2

REPORT DATE	AREA		YIELD PER HECTARE		PRODUCTION	
	1,000 Hectares	% Change 1/	Quintals	% Change 1/	1,000 Metric Tons	% Change 1/
Dec. 21, 73 WW Planted	2/ 20,656		20.0		41,190	
January 22, 1974						
Intentions						
Durum	2/ 1,821					
Other Spring	2/ 5,908					
March 14, 1974						
Intentions						
Durum	2/ 1,717	-5.7				
Other Spring	2/ 6,223	+5.1				
May 1, 1974						
Winter Wheat	18,540	-10.2	23.7	+18.5	43,874	+6.5
July 11, 1974						
All Wheat	25,771		20.3		52,391	
Winter	18,757	+1.2	20.4	-13.9	3/ 41,677	-5.0
Durum	1,488	-18.3	18.3		4/ 38,182	-8.4
Other Spring	5,526	-6.5	20.8		2,725	
August 12, 1974					11,482	
All Wheat	25,941	+0.7	19.3	-4.9	50,073	-4.4
Winter	18,879	+0.6	20.1	-1.5	37,924	0.7
Durum	1,512	+1.6	15.3	-16.4	2,320	-14.9
Other Spring	5,550	+0.4	17.7	-14.9	9,829	-14.4
September 11, 1974						
All Wheat	25,941	+0.7	18.8	-2.6	48,761	-2.67
Winter	18,879	+0.6	20.0	-0.5	37,851	-0.27
Durum	1,512	+1.6	14.1	-5.9	2,133	-8.1
Other Spring	5,550	+0.4	15.8	-10.7	8,776	-10.7
Oct/Nov 1974						
All Wheat	25,941	+0.7	18.7	-0.7	48,460	-0.6
Winter	18,879	+0.6	20.0	-0.5	37,851	0.0
Durum	1,512	+1.6	14.0	-0.7	2,123	-0.5
Other Spring	5,550	+0.4	15.3	-3.2	8,485	-3.3

1/ Percent change from previous estimate.

2/ Area (to be) planted.

3/ June 1 Indicated.

4/ July 1 Indicated.

and percent of adjustment over time. It should be noted that this table reflects the results of the unusual weather situation during 1974, and the impact such weather can have on the accuracy of crop estimates. Under normal circumstances, the initial forecasts would be within 5 percent of the final estimate.

The SRS reporting system is also moderately constrained through limited use of data processing techniques and limited use of available meteorological data.

The SRS Survey Division currently maintains, in computer machinable form, production estimates for most commodities from the 1800's to 1959, and area, yield, and production estimates from 1964 to the present time. The more recent data on area, yield, and production includes all reported commodities; however, only the official final estimate for the year is available. In addition to this limited data base, data input from some State offices is constrained by having to be delivered via mail. This is not entirely true as some State offices can enter data via the INFONET system or transmit the data via teletype or facsimile.

At this time a development effort is underway within SRS to create an SRS data system which will eliminate the data handling constraints discussed above. The new SRS data system will be composed of various subsystems related to SRS functional areas. The crop subsystem will include an Official Estimates Data Base which will contain estimates made by the Crop Reporting Board at each scheduled report date. It is also anticipated that State estimates will be entered directly as recommendations, via telecommunications, and the data base will aid the Crop Reporting Board in its review process. Special computer security procedures and techniques will also be extensively used in this system. This development effort appears to be well planned and logically organized for supporting SRS information and reporting needs.

The limited use of meteorological data by SRS in making current forecasts and estimates is due to the SRS reporting methods which are designed to reflect the effects of weather on crop production to the date of the surveys. Short and long term weather forecasts have not been utilized due to the lack of localized precision in such forecasts needed to evaluate prospects at the State level. Objective yield models used by SRS rely on actual measurements rather than subjective appraisals of crop developments.

2.4.3.4

Conclusions

- a. The major constraints within the SRS crop estimating process are: (1) the timeliness of data received; (2) the ability to assess the impact of future weather on crop conditions.

b. The present effort to develop a comprehensive SRS data system will greatly enhance the internal data handling processes of SRS and provide quicker access for the public to historical records of forecasts and estimates for comparative purposes.

2.5 SPECIAL EVENT REPORTING

2.5.1

Requirement

Within the existing USDA foreign and domestic crop estimation processes is a requirement for obtaining detailed information on events which may impact the agricultural output of a major crop production country or region. These events can be defined as natural or man-induced phenomena which could reduce or increase a country's crop production and thus cause a corresponding effect on that country's imports or exports. The Special Event Reporting requirement is an additional application associated with the Crop Production Estimates requirement which permits rapid identification and notification of the area, extent and potential agricultural impact caused by the event.

2.5.2

Existing System

Special event reporting within the context of this requirement is defined as natural disasters including floods, severe weather conditions, crop disease, insect infestations, or man-induced events such as improper application of chemicals, overgrazing, use of improved crop strains, irrigation, and cultivation of previously unused land, or policy decisions to the farm land, are a few examples of the types of events which could impact a country's crop production.

2.5.3

Data Analysis

Under the current USDA system, the Agricultural Attaches, State Department, and international news services report disaster situations that will affect crop production in a given country or region. Analysis of these reports results in the development of an estimate of the potential impact on the crop or crops effected. In the U.S., this analysis may involve the use of mathematical models to compute the probability of effect on total production based on

historical data. In foreign areas, committee assessment of the situation based on a subjective analysis and previous experience of USDA and State Department personnel familiar with the geographic area may be used to determine impact on total production.

2.5.4

Constraints in the System

Special event reporting as presently accomplished within the USDA system usually meets the required timeliness criteria. However, the system can be seriously constrained in its ability to determine with reliable accuracy the degree and extent of damage and its relationship to total crop production. This situation is largely due to the inability of a qualified agricultural specialist to visit a disaster area, for political or safety reasons, and to visually observe the impact on the agricultural area.

For example, the 1972-73 Soviet Union and Australian wheat crops were substantially reduced by winter kill and drought respectively. The impact of these disasters was not fully realized until after harvest. These shortfalls resulted in increased imports of wheat by the Soviet Union amounting to about 11.5 million metric tons while Australia reduced exports by about 3.2 million metric tons.

Special event reporting is not limited to one point in time or disaster situations, but can also be applied to those events which may occur over a period of several years such as a change in cropping practices which may result in better yields, or where previously uncultivated land is brought into cultivation, as is thought to be taking place in the Peoples' Republic of China (PRC) today.

A secondary constraint of this event reporting function is that USDA does not currently have a computerized simulation system, where various parameters of climate, meteorology, crop calendars, and historical data on a geographic area can be merged and manipulated against the event data and produce a revised estimate for the country or region. Events of hazards to winter and spring wheat grown in the U.S., which are considered criteria against which the USDA conducts analysis, are shown on Tables 2-3 and 2-4, Growth Stages and Hazards of Wheat - USDA (Winter and Spring).

2.5.5

Conclusions

- a. The existing special event reporting function in some instances could be improved in accuracy and possibly

GROWTH STAGES AND HAZARDS OF WHEAT - USA (WINTER)

TABLE 2-3

EVENT

PLANT & EMERGE

TILLERING

DORMANT

JOINTING

BOOT

HEADING

MATURING

HARVEST

HAZARD

RUST & SMUT

INSECTS & DISEASE

DROUGHT

FREEZE

FLOOD

LODGING

HAIL

SNOW

WINTERKILL

SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
PLANT & EMERGE											
TILLERING											
DORMANT											
JOINTING											
BOOT											
HEADING											
MATURING											
HARVEST											
RUST & SMUT											
INSECTS & DISEASE											
DROUGHT											
FREEZE											
FLOOD											
LODGING											
HAIL											
SNOW											
WINTERKILL											

GROWTH STAGES AND HAZARDS OF WHEAT - USA (SPRING)

TABLE 2-4 .

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
EVENT												
PLANT & EMERGE												
ILLERING												
JOINTING												
BOOT												
HEADING												
MATURING												
HARVEST												
HAZARD												
RUST & SMUT												
INSECTS & DISEASE												
DROUGHT												
FREEZE												
FLOOD												
LODGING												
HAIL												
SNOW												

timeliness by utilizing a LACIE-type system to monitor crop conditions and provide an indication of an event prior to its occurrence and to measure the actual area effected by the event after occurrence.

b. A system intended to support the special event reporting requirements of the USDA analyst must include criteria for hazard conditions which can be correlated to crop calendars by crop type in a specific geographic area.

2.6 MARKET STABILIZATION AND DEVELOPMENT

2.6.1

Requirement

Underlying the two previous requirements is the requirement to develop a system which has the capability to assist USDA analysts and decision makers in maintaining a stable market in wheat, through market development activities and statutory programs. On the domestic scene, USDA is interested in a rapid but orderly conversion to a supply and demand marketing system with limited Government controls for U.S. agricultural products. To continue and achieve this conversion will require more accurate and timely production information, along with the capability to disseminate this information to the U.S. farmer.

2.6.2

Existing System

The U.S. farmer, agriculture-dependent business firms, and the consumer benefit from a stable cereal grain market. This equates to an adequate supply of grains for the user of consumer with a suitable return to the farmer for his crop. Thus, a primary goal of the USDA is to promote stability in the wheat market through various statutory programs and authorities which are used to implement Administration policy. The following section provides a general overview of the domestic and international programs for which enabling legislation exists or which are in effect in some form today. This overview does not address all programs nor does it go into great detail, but is intended to show how information on crop production can be used to aid in market stabilization and development.

2.6.3

Domestic Programs

- a. Set-aside program, whereby farmers may set land aside from wheat production to earn program payments. Set-aside acreage amounts can be raised, lowered or removed entirely as is currently the situation.
- b. Yearly wheat acreage allotments, which can vary in size. Compliance with the acreage allotment may or may not be made a condition of eligibility for a wheat loan. For 1975, all wheat is eligible for loans regardless of allotment.
- c. Wheat price support loan programs, whereby a farmer can get a nonrecourse loan at a predetermined rate per bushel. The loan rate can also be raised or lowered depending on current supply, demand or existing policy to promote the production of wheat.

2.6.4

International Programs

- a. Public Law 480 program, whereby U.S. produced wheat can be sold for foreign credits or foreign aid which can include gifts. The level of PL-480 sales can be tailored to U.S. and world conditions. For instance, in periods of high demand and short supply, PL-480 sales can be reduced to encourage foreign purchase to improve the U.S. balance of trade.
- b. Export subsidies (e.g., transportation differential) program, whereby subsidies are paid to U.S. exporters to enable them to compete in the world market when the domestic wheat price is above the world market price. The subsidy can be raised, lowered, or eliminated. At this time no subsidy payments are being made for wheat exports.
- c. Long-range sales contracts which enable foreign customers to contract with U.S. exporters for future wheat deliveries. There is presently substantial interest in this area as a rational approach to stabilize the supply and demand marketing environment.

2.6.5

Data Analysis

To compete in a free market, the U.S. farmer must have available to him information that will assist him in making decisions about

what crops to plant, how much to plant, and when to sell his harvested crop. This information is available to farmers through the crop estimate and reporting process described earlier, though non-Government sources, and also through information and assistance provided by various market development activities in USDA.

Market analysts within the FAS Foreign Market Development area assist market development organizations in the preparation of information concerning U.S. products and in identifying market areas in foreign countries. To accomplish this function, market analysts rely upon crop estimates produced by FAS commodity analysts ERS country analysts and SRS reports.

Through a knowledge of supply, demand, surpluses, deficits, trading practices and current crop production estimates, the market analyst can predict potential shifts in market demand and influence or recommend promotional activities for U.S. wheat producers.

2.6.6

Constraints in the Process

The market analyst depends primarily on crop production estimates prepared by FAS, ERS, and SRS. Presently, the market analyst obtains this information through hardcopy published reports or computer printouts which are updated on a monthly basis. Applying those constraints previously described in sections 2.4 and 2.5 concerning crop production estimates and special event reporting, it can be understood that the market analyst can be constrained in making timely and accurate judgments concerning market decisions.

2.6.7

Conclusions

a. Under the existing reporting system, the market analyst and others concerned with international trade policy and PL-480 programs are limited to essentially a manual process when developing advanced market plans or predicting shifts in the world grain trade situation. This manual process in itself will tend to limit the number of various market plan alternatives which may be developed.

b. The development of an integrated crop production estimates data base and specially tailored applications for the market analyst would provide a substantially improved market planning tool. The data base would provide the analyst with current crop production data to be queried for his subjective review or as input to economic or statistical models which would

then enable manipulation of the data against a variety of variables or alternatives and result in various marketing plans.

2.7 METEOROLOGICAL INFORMATION PROCESSING

2.7.1

Requirement

Associated with the preparation of USDA crop production estimates is a requirement to obtain and analyze incoming meteorological information and assess its impact on a specific commodity in a given geographic area. This information requirement has been briefly mentioned in earlier sections and is addressed in more detail here.

2.7.2

Existing System

At the present time, meteorological information is available to agencies within USDA through the Agricultural Weather Support Service (AWSS). This service is provided through the National Weather Service, as part of NOAA. AWSS is located in the South Building (Room 1137) and provides service and assistance through a staff of meteorologists.

The primary function of the AWSS is to provide weekly and monthly summaries of weather and crop conditions on the U.S. and to a lesser extent in other areas of the world. Much of this information is assembled and published in the Weekly Weather and Crop Bulletin. The bulletin is a joint publication prepared by AWSS and the Crop Branch of SRS. Weather data received by AWSS from the National Meteorological Center in Suitland, Maryland, and weather related crop information received by the Crop Branch from State Statistical Offices is included in the bulletin.

2.7.3

Data Analysis

The analysis of current weather data, and its impact on crop growth, by USDA analysts is important because of its effect on final crop production, specifically yields and the general world food situation. FAS, ERS, and SRS analysts have access to daily, weekly, and monthly weather reports to assess the impact on crop development. FAS and ERS analysts on the Soviet and PRC task force

units discuss the probable effect of weather in those areas. SRS relies on its surveys to reflect the effects of weather to date in making their crop forecasts. Weather events following a survey can have adverse affects which are not reflected in the forecasts based on the survey. In 1974, two freezes one in early September and one in early October hit the corn belt shortly after the respective surveys. The impact of these freezes was not reflected in the respective forecasts.

2.7.4

Constraints

Although AWSS does provide an advisory and assessment capability on weather related crop problems, a large proportion of weather analysis is done by the FAS and ERS analysts. This analysis and assessment is subjective in nature and may not include all parameters that should be considered. This is also partly because not all information required in making assessments is available. For example, the World Meteorological Organization inputs from meteorological stations throughout the world include six mandatory and one optional item of information. The optional item is precipitation for the previous six hours. Many stations do not provide this item and thus, a critical element in assessing crop growth is missing. The WMO network of meteorological stations and its associated Global Telecommunications System (GTS) are primarily interested in providing information for aviation uses rather than agricultural uses.

Another constraining factor in the USDA exploitation of available weather data is the lack of computer assisted application that would permit more objective analysis of the data. For example, weather data is most easily studied in a visual display format (map); hence, the popularity of the weather maps in the Weekly Weather and Crop Bulletin. Complications increase, however, when the analyst tries to relate the weather map to the location, area and crop growth state of half a dozen crops. Often sparse or missing network data preclude accurate construction and interpretation of these maps, especially in foreign regions. The second half of this problem is knowing what the accumulated effect of the weather has been on a given crop. Through the application of existing computer technology, these constraints can be substantially reduced. First, available weather data and map outlines of the world similar to those in the weather bulletin could be displayed on a graphic computer terminal. Additionally, the location and area of a selected crop along with a computed crop calendar could be added to the display by the analyst. Secondly, selected weather data could be accumulated over a specified geographic area and the analyst could execute a crop growth or yield model to ascertain the condition of the crop. USDA presently does not have operational crop growth models suitable for application in conjunction with crop production estimating.

2.7.5

Conclusions

- a. Meteorological data is important to USDA analysts in determining the condition of major crops throughout the world, and in assessing the impact of weather on the agricultural production of a country or region.
- b. The existing system for obtaining available meteorological data through the AWSS is reasonably effective but could be improved through the expansion of the AWSS facility and access to complete meteorological data from WMO, satellites, and other sources.
- c. The existing methods and techniques by which USDA personnel subjectively analyze meteorological data requires improvement through increased application of available computer technology and resources in the areas of current weather observations and computer modelling utilizing meteorological and climatological data as a factor which affects crop growth and yield potential.

SECTION 3.0 DETAILED INFORMATION REQUIREMENTS

The previous section discussed, in general terms, the existing methods within USDA that support the preparation of crop production estimates. This section presents specific information on the data required by USDA in terms of content, format, accuracy, and frequency. The material presented applies to wheat production estimates and will serve as a basis for USDA evaluation of LACIE.

3.1 WHEAT PRODUCTION ESTIMATES

LACIE wheat production estimates for both foreign and domestic areas will be prepared and forwarded to the USDA LACIE Project Office on a scheduled basis. The reports will contain area, yield, and production estimates for winter and spring wheats for the United States and the selected LACIE countries. In addition to providing wheat production data, the reports should reflect the statistical facts relating to the LACIE process. This information would include: the number of sample segments reviewed for each phase, the number of sample segments obscured by clouds, the ratio of photo-analyzed versus ADP-analyzed segments, area of each Bio-phase analyzed and number of segments rejected as unprocessable.

3.1.1

Area Estimates

Initial Phase I area determinations will be for wheat in the Great Plains. As capabilities permit, area determinations of other U.S. areas may also be made. Data received at USDA from the LACIE system must be expressed in terms that are meaningful to the USDA user. All area estimates for the U.S. wheat growing areas shall be expressed in acres, all foreign areas shall be expressed in hectares.

3.1.1.1

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Domestic Area Estimates

Estimates of wheat area in the U.S. Great Plains will be provided at the State level as a minimum, although estimates are desirable to the Crop Reporting District level. The State area estimates will be aggregated into a national estimate of total acreage. All acreage figures will be rounded to the nearest 1,000 acres.

3.1.1.2

Foreign Area Estimates

Estimates of wheat area in the selected LACIE countries will be made for the smallest political subdivision feasible. These estimates will then be aggregated to regional and country estimates. All foreign estimates of area will be stated in hectares.

3.1.2

Yield Estimates

During Phase I, yield estimates will be provided for the selected U.S. test areas based on historical information available from those areas being analyzed for area determinations. No foreign yield estimates are planned or required during Phase I. All domestic yield figures will be stated in bushels per acre rounded to the nearest 1/10 of a bushel.

During Phase II, the results of the Research, Test, and Evaluation of the yield and production feasibility test in the U.S. will be operationally tested. At this time yield estimates for both the U.S. areas and LACIE selected countries will be produced and aggregated with area estimates to produce wheat production estimates. Foreign yield figures will be stated in quintals per hectare.

3.1.3

Production Estimates

Wheat production estimates of selected U.S. test areas will be produced during Phase I using the LACIE derived area measurements and historical yield data. These production estimates will be provided on a scheduled basis as outlined under Reporting Requirements, 3.1.4. U.S. production estimates will be expressed in bushels rounded to the nearest 1,000. Wheat production estimates for the LACIE selected countries will be produced in Phases II and III. These estimates will also be provided on a scheduled basis as described in Reporting Requirements. Foreign production estimates will be expressed in metric tons rounded to the nearest 1,000.

3.1.3.1

Accuracy of Domestic Estimates

The accuracy of crop estimates for the U.S. are a factor of significant importance in statistical crop estimating. Generally, there is a wide variation in sampling error and the level of

confidence associated with each estimate, depending upon the data source used for estimators. For example, data collected by mail questionnaires on acreage versus data obtained from sample enumeration-type surveys, objective yield surveys versus farm reporting yield, etc. The typical sampling error expected for major agricultural items from the June enumerative survey is about four to eight percent on a State basis, about two to three percent on a regional level, and about one to two percent for U.S. totals.

Table 3-1 represents the accuracy requirements for U.S. estimates expected from LACIE during the experimental stages only; it should not be used for or implied that these would be the acceptable level of accuracy from an operational program. The main emphasis during the experimental stages will be the development of yield forecast models and of acreage classification procedures which will produce results that are highly correlated with independently obtained USDA estimates of yield and acreage for the same regions. USDA will require that all estimates from LACIE be accomplished by some measure of the statistical reliability of the estimate. For yield estimates, this could be related to the standard error of the forecast yield. For acreage, this would be at least the sampling error of the estimated acreage. The coefficient of correlation between the LACIE estimation of wheat acreages and recent USDA estimates for small areas such as counties would also be desired.

Accuracy requirements for an operational program are yet to be determined and are not contained in this text.

3.1.3.2

A Accuracy of Foreign Estimates

The requirement for accurate information provided by the LACIE, in the form of area, yield, and production estimate data, is difficult to define. During the data collection phase of this analysis, foreign commodity analysts in FAS and ERS were queried about their present and desired accuracy and reliability requirements. Their responses for accuracy ranged from a high of 98% to a low of 75% for a final wheat estimate for a given country. The average acceptable accuracy was $\pm 10\%$ of final wheat production. Since initial estimates of hectareage planted in wheat will differ from the final estimate of hectareage actually harvested due to weather or economic factors, the initial estimates will usually have a lower expected accuracy than later estimates. Therefore, LACIE estimates would be expected to improve in accuracy during the wheat growth cycle and also improve as the project progresses through three crop years.

Table 3-2 represents the accuracy requirements for selected LACIE countries during the experimental stages of LACIE. These levels

	Phase I 1975-1976	Phase II 1976-1977	Phase III 1977-1978
	Estimate ^{1/}	Estimate ^{1/}	Estimate ^{1/}
Initial			
Planted Area	+20%	+15%	+15%
Yield	+20%	+15%	+15%
Production	+20%	+15%	+15%
Mid-Season			
Planted Area	+15%	+10%	+10%
Yield	+15%	+10%	+10%
Production	+15%	+10%	+10%
Post-Harvest			
Harvested Area	+10%	+10%	+10%
Yield	+10%	+10%	+10%
Production	+10%	+10%	+10%
Final			
Harvested Acres	+10%	+10%	+10%
Yield	+10%	+10%	+10%
Production	+10%	+10%	+10%

^{1/} As compared to the final USDA estimate.

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 3-1

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OF POOR QUALITY

	Phase II	Phase III
	Estimate ^{1/}	Estimate ^{1/}
Initial		
Planted Area	$\pm 20\%$	$\pm 15\%$
Yield	$\pm 20\%$	$\pm 15\%$
Production	$\pm 15\%$	$\pm 10\%$
Mid-Stage		
Area	$\pm 20\%$	$\pm 15\%$
Yield	$\pm 20\%$	$\pm 15\%$
Production	$\pm 15\%$	$\pm 10\%$
Pre-Harvest		
Area	$\pm 20\%$	$\pm 15\%$
Yield	$\pm 20\%$	$\pm 15\%$
Production	$\pm 15\%$	$\pm 10\%$
Final		
Area	$\pm 15\%$	$\pm 10\%$
Yield	$\pm 15\%$	$\pm 10\%$
Production	$\pm 10\%$	$\pm 10\%$

^{1/} As compared to the final USDA estimate for each country.

Table 3-2

should not be considered final acceptable levels of accuracy for an operational program. It will be required that all estimates from LACIE be associated with all the required statistical analysis of expected accuracy levels.

3.1.4

Reporting Requirements

Reports containing wheat crop area, yield, and production estimates for the U.S. and the selected LACIE countries will be prepared and forwarded to the USDA LACIE Project Office on a scheduled and unscheduled basis. Scheduled reports will consist of area, yield and production data, along with related statistical information associated with the generation and aggregation of the estimates. Unscheduled reports identified as special event or contingency reports will be provided on an ad hoc basis when events occur that may impact estimates previously generated.

The ability of the LACIE system to produce accurate wheat estimates in a timely manner is the most critical factor in evaluating the LACIE. Data must be received at USDA in sufficient time to be of value.

3.1.4.1

Scheduled Reports

The secondary LACIE objective of processing and delivering LANDSAT data to analysts within 14 days will be the key factor in generating LACIE reports of wheat estimates. The minimum acceptable reporting period for the LACIE demonstration test will be every 30 days. Reports of crop production for the LACIE countries would not be expected until Phase II. Figure 3-1 outlines the reporting requirements as related to the LACIE phasing objectives. Appendix E contains the 1975 Crop Reporting Board schedule for planning purposes.

3.1.4.2

Unscheduled Reports

Unscheduled or special event reports, as described in section 2 (2.5) will be reported on an as-observed basis. These reports will include, as a minimum, a detailed narrative of the event, the physical location of the event, the boundaries and measured area affected, and if possible, a percentage estimate of the impact of the event on wheat production. Special event reporting should

	Phase I	Phase II	Phase III
U.S. Study Areas	Monthly Area Yield Production Statistical Summary	Monthly Area Yield Production Statistical Summary	Monthly Area Yield Production Statistical Summary
LACIE Countries		Monthly Area Yield Production Statistical Data	Monthly Area Yield Production Statistical Data

REPORTING REQUIREMENTS OUTLINE

Figure 3-1

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not necessarily be restricted to wheat only, but should be thought of as an indications and warning function for the LACIE study areas. Figure 3-2 contains a list of special events that could result in a report.

Special event reports may be either one-time reports or continuous reports prepared on a daily basis during the course of an event. For example, a late spring freeze would be a one-time report indicating the area, extent and potential impact of the freeze. Special reports on flooding might cover a longer period of time as the flood moves through various areas.

3.2 METEOROLOGICAL DATA REQUIREMENTS

The first phases of the LACIE project are primarily concerned with area measurements of the U.S. and Canada. Adverse weather could conceivably cause revisions in these area estimates because of abandonment, where a wheat crop is so marginal it is not economically practical to harvest. During Phase II, yield model(s) will be tested and evaluated for the U.S. In order for the USDA LACIE project personnel to evaluate area estimates and determine if revisions are required due to weather conditions, and to be prepared to evaluate the effectiveness of yield modelling efforts, processed meteorological data must be available within the LACIE system on a continuous basis.

The meteorological data and assessment capability presently provided by AWSS will temporarily satisfy USDA LACIE evaluation requirements. However, this capability must be expanded in the near future to provide more complete and reliable meteorological data on a worldwide basis. Table 3-3 lists the meteorological data currently available through AWSS. The additional data required to support LACIE evaluation needs are listed in Table 3-4. This information can be feasibly provided through the National Meteorological Center in Suitland, Maryland. To reduce the amount of time required to access and analyze this data in terms of its agrometeorological implication, a computer capability similar to that currently in operation at the Johnson Space Center (JSC) will be eventually needed within USDA. This capability permits the retrieval and display of current meteorological data on a world-wide basis. Graphic display of geographical areas overlaid with meteorological data, is a major feature of this capability. Such a capability could be located within the USDA environment and operate during normal duty hours. It would contain a data base of information reflecting the past 12 hours of meteorological activity.

3.3 YIELD MODELLING

The development and operation of yield model(s) for predicting the potential yield of wheat in a specific geographic area is a

LIST OF POSSIBLE SPECIAL EVENT REPORTS

EVENT	POSSIBLE CAUSE
Wheat Rust	Temperature and humidity
Wheat Smut	Humidity
Drought	Intensity and duration
Freeze	Fall, sudden freezes before snow cover; spring, early greening
Flooding	Fall and spring planting
Insect Damage	
Disease Damage	
Wind Damage	Lodging
Hail Damage	
Snow	Cover and depth
Winterkill	Frost heaving
Fertilizer Use	Decrease or increase; cultivation of previously uncultivated areas.

Figure 3-2

TABLE 3-3

METEOROLOGICAL DATA CURRENTLY AVAILABLE TO THE USDA
FROM THE AGRICULTURAL WEATHER SUPPORT SERVICE OFFICE

Codes:

T - Teletype precipitation

M - Maps B - Published in Bulletin

PARAMETER	DATA FREQUENCY							
	FOR U.S.A.				GLOBAL COVERAGE			
	6 HR	24 HR	WEEKLY	MONTHLY	6 HR	24 HR	WEEKLY	MONTHLY
Surface Temp	T-M		B(T)	B(T)	M			B(T)
Max-Min		M	B	B				
Anamolies			B	B				B
Precipitation	T-M	T-M	B(T)	B(T)				B(T)
Dewpoint-Vapor Pressure	M			T	M			T
Wind Velocity- Dir	M				M			
Sky Cover (Cloud)	T-M				M			
Past & Current Weather	T-M				M			
Upper Air Data 850,700,500mb	M							
Surface Analyses	M				M			
Snow Cover		M	B(T-M)					
Growing Degree Days			B(T)					
Percent Possible Sunshine				B				
Palmer Drought Index			B	B				
Crop Moisture Index			B	B				
Forecasts:								
48 hr		M						
5 day		M						
30 day				M				
90 day				seasonal				

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TABLE 3-4

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METEOROLOGICAL DATA THAT WILL BE REQUIRED IN A
METEOROLOGICAL SUPPORT SYSTEM WITHOUT DEFINITION OF SOURCE OR FORM,
IN ADDITION TO EPISODE REPORTS

PARAMETER	FREQUENCY OF ROUTINE REPORTS (FOR ALL GRAIN PRODUCING AREAS)		
	24 HR	WEEKLY-10 DAYS	MONTHLY
Surface Temp	X	X	X
Max-Min	X		
Anomalies	X	X	X
Precipitation - Total	X	X	X
Duration-Intensity-Coverage	X		
Anomalies		X	X
Dewpoint-Vapor Pressure	X	X	X
Wind Veloc - Dir	X	X	
Indication of Max	X		
Sky Cover (Clouds-No Clouds)	X	X	
Snow Cover & Depth	X	X	
Radiation, Solar	X	X	X
Radiation, Net	X	X	X
Soil Surface Temps	X	X	X
Upper Air Data - Multi-level	X	X	
Pressure Anomalies		X	
Derived Met Products:			
Drought Index		X	
Soil Moisture Index or Values		X	
Flood Coverage & Duration		X	
Degree Days		X	
Indices for Insect & Disease Development		X	
Forecasts:			
2-7 Days	X	X	
Monthly		X	X
Seasonal		X	X

major LACIE objective. USDA interest in crop yields reflects a basic and continuing concern of the Department. Concern with yield is an integral part of the economic research and statistical reporting of the Department. Therefore, the USDA LACIE Project Office and its staff intends to actively participate in the development and testing of wheat yield model(s) for the LACIE.

3.3.1

Model Development

The National Oceanic and Atmospheric Administration (NOAA) will be responsible for the design, development, testing, and evaluation of yield models which relate crop yields to meteorological and climatic conditions. Additionally, NOAA will provide model inputs of climate and meteorological data from ground stations and environmental satellites. It is expected by USDA that yield model development will be evolutionary in nature and will include investigations and testing of alternative methods and techniques for establishing relationships of weather and crop yield.

In the context of LACIE, USDA requires the best yield information available in order to achieve desired levels of accuracy in estimates of total production. Acreage data, derived from LANDSAT, will be of limited value if accurate and reliable yield information is not available. Consequently, USDA is not only concerned with the methodologies and techniques used to develop wheat yield models, but also with the quality, accuracy and reliability of the basic data used to derive yield estimates through a yield model.

3.3.2

Model Testing

During Phases II and III of the LACIE effort, wheat yield models developed by NOAA will be tested and evaluated. Yield model testing and evaluation will be accomplished by USDA in conjunction with other LACIE RT&E efforts. USDA LACIE personnel will participate in the testing and evaluation of wheat yield models and when necessary will obtain assistance from the Agricultural Research Service (ARS).

It is expected that the yield models will be modular in design and structure to permit integration into the USDA LACIE system design concept discussed in section 4.0.

Protein Assessment

Protein content of wheat influences the market value of wheat. The percentage of protein in wheat is a USDA information requirement that should be considered in wheat yield model development. The protein content of wheat depends primarily on two factors, heredity and environment. The heredity or genetic factor determines the quality and quantity of protein in wheat and is generally controlled by standard wheat varieties. Environmental factors such as soil type, amount, frequency and timing of rainfall, sunshine, temperature, etc., also determine the amount of protein. The feasibility of including additional factors that influence protein development should be investigated during wheat yield model development.

3.4 REGISTRATION OF LANDSAT MULTISPECTRAL DATA

Accurate registration of sample segments to a known geographic position on the earth's surface and also to a cartographic base is a USDA requirement. Without adequate registration of LANDSAT data to a cartographic base, it will be difficult to accurately evaluate and assess the performance of analysts in the classification of wheat areas. Additionally, the inability to correlate a selected sample segment to known geographic position will preclude the comparison of statistical or enumerative data by USDA with the results of the LACIE processing.

3.4.1

Registration Accuracy

The desired USDA registration accuracy requirement is 80M rms* at a scale of 1:250,000.

3.4.2

Cartographic Base

The USGS 1:250,000 scale topographic maps and the Defense Mapping Agency 1:250,000 scale Joint Operations Graphic - Air, both using the Universal Transverse Mercator (UTM) projection, are recommended as the standard LACIE cartographic base.

The feasibility of utilizing the Space Oblique Mercator¹ projection should also be analyzed to determine if it is suitable for USDA registration requirements.

¹ Colvocoresses, A.P., Space Oblique Mercator, Photogrammetric Engineering, August 1974.

3.5 RESEARCH AND DEVELOPMENT

During the LACIE, various Research and Development (R&D) efforts will be conducted by the participating agencies and various supporting academic institutions. USDA is not directly contributing to this basic and applied research; however, USDA experience in research activities and ongoing LACIE general observations of R&D activities indicate the need for an integrated research plan.

Participation in the development of an integrated R&D plan is a USDA LACIE requirement. Within available resources, USDA personnel will also participate in the guidance, review and evaluation of R&D activities.

3.6 LACIE SECURITY REQUIREMENTS

3.6.1

Responsibility

Information security regarding the LACIE produced agricultural estimates will be the lead responsibility USDA, as broadly defined by the Memorandum of Understanding. USDA LACIE personnel will insure that established security procedures for the handling and release of sensitive LACIE information are adhered to by all LACIE participants. During the initial phase of LACIE, security procedures, following the guidelines presented in this section, will be developed in coordination with NASA and NOAA. These procedures will be revised or changed as required during the course of the project.

The security measures imposed by these guidelines and procedures are to temporarily protect specific crop production data from unauthorized release until such time as the Crop Reporting Board releases their reports.

3.6.2

Definition

It is not anticipated that LACIE will produce classified information which requires protection in the interests of national defense, as defined in Executive Order 11652. It is anticipated that LACIE will produce information of commodity market value which, in specific instances, requires secure handling until it is released by the USDA. This information is commonly referred to as speculative data.

Speculative data are defined to be data relating to corn, wheat, oats, cotton or soybeans, the assembling and collating of which

would make it possible for any member, members, or assistants of the Board approximately to anticipate the Board's forthcoming report for the United States on the condition, yield, probable production, or farm stocks of designated commodities, or the acreage or ginnings of cotton.

Speculative data for wheat includes:

Winter wheat in Illinois, Indiana, Kansas, Missouri, Montana, Nebraska, Ohio, Oklahoma, Texas, and Washington.

Spring wheat in Idaho, Minnesota, Montana, North Dakota, South Dakota, and Washington.

3.6.3

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Guidelines and Procedures

The following guidelines and suggested procedures will be addressed in the preparation of a joint LACIE security procedures document. Security procedures will be divided into three categories: document control security, personnel security, and computer security. Appendix F contains specific USDA regulations that will serve as a basis for the development of procedures to be followed by LACIE personnel during the period of the project. Additional guidelines related to LACIE activities are outlined in the following paragraphs.

3.6.3.1

Document Control Security

Document control security is concerned with the administrative procedures for the handling of all reports, studies, graphics, computer printouts and other hard copy materials resulting from the LACIE that contain agricultural information. Specific procedural areas to be addressed in the document control security procedures categories are outlined below:

- USDA administrative control of test and operational products.
- Destruction of test products by USDA personnel.
- Transmission of products to Washington, D.C. for dissemination
- Maintenance of document/product log.
- Document/product review procedures.
- Coordination of area/estimate information with appropriate
USDA personnel prior to release.
- Release of information to the public.
- Responses to queries by interest groups.
- Release of technical methodology (NASA).

Release of analytical methodology (USDA).
Release of progress reports.
Approval and coordination of briefing, press releases, memorandum, reports and software documentation.

3.6.3.2

Personnel Security

Personnel security is concerned with administrative procedures to be followed by the LACIE personnel during the course of the experiment. Personnel security will be applied primarily through the principle of "need-to-know". Individuals, depending upon their responsibilities within the LACIE project, will have access to or a need to know certain types of information. Individuals at management levels and in the crop assessment area will have the greatest need; however, photo interpreters and ADP classifiers will not have a need to know yield information being developed within the yield model area. This principle of need to know will be applied in the development of administrative procedures related to personnel security.

Specific procedural areas to be addressed in the personnel security procedures are outlined below:

- Introductory security briefings to all LACIE personnel.
- Administration of security oaths to individuals who have access to most information.
- Instructions on the release of papers or presentations at professional society conventions and seminars.
- Exit briefings for personnel leaving the project.
- Discussions with contractor representatives or other individuals outside the U.S. Government.
- Control of working papers and related materials.

3.6.3.3

Computer Security

Computer security is concerned with those procedures and safeguards employed to prevent access to LACIE data base information by unauthorized individuals. The concept of need-to-know must also be applied to that speculative data resident in the LACIE data base. All data files or subsystems containing area, yield, and production estimates in digital form must be protected from inadvertent destruction, or disclosure to unauthorized persons. To satisfy this requirement, a variety of computer security procedures and techniques must be designed, developed and implemented with the LACIE system. Techniques, including access codes for computer usage, logical and physical lock-outs of computer terminals, and

file access, read/write permission password provisions, are to be used whenever possible and practical.

The following security and data handling requirements for wheat production information shall be implemented concurrent with the initial automated aggregation of area and yield data.

3.6.3.3.1

Procedural

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Require personnel who have been selected for access to wheat production data to read and sign the certificates contained in Appendix F.

Within a system of access codes, restrict the loading and operation of the aggregation software. Persons having access to this software shall store the source and object decks in a secure lockable container (safe) along with associated listing and program documentation.

When the data base is to be accessed for the purpose of aggregating area and yield data, a designated USDA employee will be present to accept the output tape.

No aggregated data shall be routinely written to intermediate files such as SYSOUT.

The output tape shall be hand-carried to Building 17 where USDA personnel will initialize software to produce the hardcopy output.

Hardcopy output tape and the print program shall be secured in a locked container when not in use.

Hardcopy mailed to Washington, D.C., shall be sent by certified mail to the LACIE Project Office.

3.6.3.3.2

System

Aggregation software shall be designed to write output in a coded format, e.g., a binary reference scheme for locating print field. This scheme will be provided by USDA.

Yield and area data shall not be stored in the same physical device, i.g. magnetic tape or disc-pack.

3.6.3.3.3

Planning

Near-term planning within the USDA is oriented toward a more sophisticated technique for data security. These requirements are predicated upon a system whose data bank is integrated to the maximum extent possible. Within this concept, the following generalized requirements are presented.

a. Hardware:

- Manual disconnect (switch) of front-end processors from the designated host system.

- Encode/decode devices associated with communications linkages.

- Manual lock/unlock of selected CRTS.

b. Software:

- Core resident security monitor to periodically check user, records/files in use and output destination.

- Passwords compiled into software modules.

- Capability to build access ciphers.

c. Data Base:

- Access codes assigned to the record level for certain records.

- Multiple validation schemes for record combinations.

3.7 DATA CODE STANDARDS

The use of standard USDA data codes for representing commodities, countries, and subdivisions within countries, was to be a USDA requirement. However, identification of a standard set of USDA data codes is not totally possible at this time as no Department-wide standard exists.

A data code is defined as a number, letter, character, or any combination thereof used to represent a data element. For example, the data code "US" might be used to represent the "UNITED STATES" in the "COUNTRY" data element.

Each of the USDA organizations concerned with reporting foreign or domestic crop estimates and with maintaining such data in

computerized files has its own distinct set of data codes for representing commodities and countries. In some cases, one organization may use multiple codes to represent the same data element.

Since the LACIE project is only concerned with the single commodity of wheat, and only with the United States and eight other countries, an interim set of data codes is recommended here, until such time as a USDA standard for commodity and country codes is established.

3.7.1

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Commodity Code

The following list of data codes for wheat is recommended for use during LACIE:

- W = Wheat, all
- WW = Wheat, winter
- WS = Wheat, spring
- WWHR = Wheat, winter, hard red
- WWSR = Wheat, winter, soft red
- WWW = Wheat, winter, white
- WD = Wheat, durum
- WDR = Wheat, durum, red
- WSHR = Wheat, spring, hard red
- WSW = Wheat, spring, white

3.7.2

Country Codes

Country codes for the eight countries to be studied during Phase III should be those found in Federal Information Processing Standard (FIPS) Publication 10-1, dated June 15, 1974. This code is a two-character alphabetic code. Expansion of this code to include political subdivisions within the country should be accomplished in a logical manner that will best satisfy LACIE project requirements at JSC.

3.7.3

United States Codes

The Statistical Reporting Service Geographic Code System is recommended as the standard coding scheme for the United States. This standard conforms to FIPS standards and satisfies other agency requirements.

SECTION 4.0 INFORMATION HANDLING REQUIREMENTS

4.1 INFORMATION HANDLING REQUIREMENTS

One of the major USDA requirements of the LACIE is to develop a system which will require a minimum conversion effort when transferred to the USDA data processing environment. As the LACIE is being developed in a center other than a USDA computer center, and since the major USDA computer centers have equipment of widely varying capability and manufacture, this task is one which will need careful planning and good design. Adhering closely to prescribed USDA and FIPS standards will aid greatly in achieving this readily transferred system.

The location of a production LACIE or LACIE-like system cannot be determined at this time. Workloads of the various computer sites can be projected two to three years in advance, but not with certainty. Economic conditions, crop harvests and new programs could all impact the throughput required of a given site. To reinforce the necessity of building a transferrable system, a summary of all major USDA computer center hardware and software capabilities is presented in the next several paragraphs. The widely varying capabilities will be evident and, hopefully, the observations formed resulting from reading this comparison will be instructive in influencing the design of a production system.

4.2 EXISTING COMPUTER SYSTEMS

4.2.1

Washington Computer Center

This Center is currently the largest and most modernly equipped of all the USDA centers. An IBM 370/168, running under the Time Sharing Option of the Virtual Memory Operating System with four million bytes of main storage forms the nucleus of the Center. Data storage devices include random access devices, with fixed and moving head, totalling approximately 10 billion character capacity, and high speed tape transports including 24 nine-track and two seven-track drives. Remote job entry and various types of CRT display and teletype devices provide a flexible communications capability.

4.2.2

Fort Collins Computer Center

A UNIVAC 1108 computer with 256,000, 36 bit words main storage, employing a UNIVAC 9300 computer with 12,000 words of memory as a front-end device for all hardcopy input/output operations, is the basis of this Center. Eight fixed head drums and eight moving head disk spindles provide a 350 million character random access storage capacity. Twelve nine-track, dual density and two seven-track tape drives add to the data storage capability. A communications controller provides a limited remote terminal capability.

4.2.3

St. Louis Computer Center

Two processors, a Burroughs 3500 with 300,000 bytes of memory and a Burroughs 2700 with 300,000 bytes constitute the St. Louis Center processing capability. A moving head disk capacity totalling 700 million bytes provides the random access storage media. Twelve nine-track, 1600 BPI, one nine-track, 800 BPI and one seven-track 800 BPI magnetic tape units provide the remainder of the data storage capability. There is currently one remote inquiry station.

4.2.4

Minneapolis Computer Center

A UNIVAC 1107 processor with 64,000 36 bit words of memory represents the processing capability of this Center. Random access storage capability is provided by two fixed head drums with a total storage capacity of approximately 38 million characters. Twelve seven-track, 200/556/800 BPI magnetic tape units complete the data storage complement. There is no terminal facility. This Center will eventually be reduced to a remote terminal facility.

4.2.5

Kansas City Computer Center

Two IBM 360/50s cross-barred to transmission control units and sharing random access mass storage devices constitute the Kansas City Center processing capability and provide complete system redundancy for back-up should one system fail. Each system has 1,024,000 character memory capacity and each is tied via a memory

channel cable to separate transmission control units which are in turn tied to wideband and switch module T-Bars for telecommunications applications. Twenty-four disk spindles, each with approximately 29 million characters storage capacity, are shared by the two systems. Additionally, one system has 16 disk spindles dedicated and the second system has eight spindles dedicated, each with approximately 29 million characters storage capacity.

4.2.6

New Orleans Computer Center

An IBM 360/65 with two million bytes of main storage supports this Center. The system operates various IBM software systems including: OS/MVT, HASP, TSO, and the telecommunications operating facility (TCAM). Data storage facilities include four eight spindle 3330s, 16 nine-track and eight seven-track tape drives. An extensive telecommunications capability for handling TTY, CRT, and RJE also exists.

4.2.7

INFONET

In addition to the USDA computer centers, USDA subscribes to the INFONET service. This service was created by Computer Sciences Corporation (CSC) in response to timesharing requirements of both business and Government data processing users. This service is based on an architecture that permits access to the system resources by users at all levels of proficiency.

The system is designed as a full-service network giving the user freedom to select the most cost-effective mode of program execution, interactive or batch for any program.

Under the Government's contract, INFONET provides nationwide coverage and national access to common data bases from its computer center in Los Angeles. This equipment operates under the Computer Sciences Teleprocessing System, and the associated telecommunications hardware connects 12 Federal Data Processing Center (FDPC) cities to the central computer.

The INFONET computer installation makes use of a standard hardware configuration incorporating components of several hardware manufacturers. The UNIVAC 1108 computer forms the nucleus of the hardware configuration. Direct-access mass storage is provided by a multiple disk drive subsystem interfaced to the central processor by dual controllers.

4.3 PLANNED COMPUTER SYSTEMS

4.3.1

USDA Departmental Integrated Systems Plan (ISP)

Described in previous sections are current capabilities found in the various computer centers. The Kansas City, New Orleans, Fort Collins and the Washington computer centers all are scheduled to be replaced within the next two years as part of the USDA Departmental Integrated System Plan. This plan is at the design and requirements identification level at the present time. The award of the mainframe contract will be made in late 1975. At that time, precise information concerning the hardware, operating system software and data management capabilities will be available.

The new Departmental Computer Service Center systems concepts is based upon a multi-CPU mainframe with mini-computer front-end processors to handle communications and other specialized tasks. These systems are required to support USDA on-line transaction oriented data base applications, interactive time-sharing applications, both remote and local, and remote batch applications. Data communications networking will be provided and will give equal capabilities to local and remote users in batch and interactive mode.

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4.3.2

Hardware Configuration

A general discussion of the mainframe front-end processors and basic software features is included in this section.

4.3.2.1

Mainframe Components

Each center will have two or more general purpose computers connected together by front-end processors. These systems will, however, be capable of operating independently. The total processing load will be shared. All peripheral equipment will be switchable to either system. The physical organization of the processors will be such that the failure of one processor will not deprive the system of its total processing capability.

Main memory size requirements cannot be defined precisely at this time; however, an amount of main memory sufficient to contain the resident system software and any application software demand is to be provided.

4.3.2.2

Front-end Processors

The front-end processors will handle all communications at the site. The basic functions will be to accept, validate, stage, log and transmit all communications between the processors, the telecommunications subsystems and the remote centers. The front-end processors will have sufficient main memory and peripheral devices to support communications buffers for full-duplex operations to the telecommunications subsystem and remote service centers, storage for handling of data and transfer to and from the processors, I/O buffers for peripheral storage devices, circuit and device tables for maintenance of security and status information about all terminals and the front-end processor software. The communications control equipment will service high speed, full-duplex data links and the remote centers. One front-end peripheral equipment; therefore, all front-end peripheral equipment will be switchable to each of the front-ends.

Figure 4-1 depicts the Departmental Computer Service Center hardware architecture concept.

4.3.3

Software Components

The basic software components of the new system will include operating system software, a data management system, transaction processor, special software packages and language processors for standard FORTRAN and COBOL programming languages.

4.4 USDA LACIE SYSTEM DESIGN CONCEPT

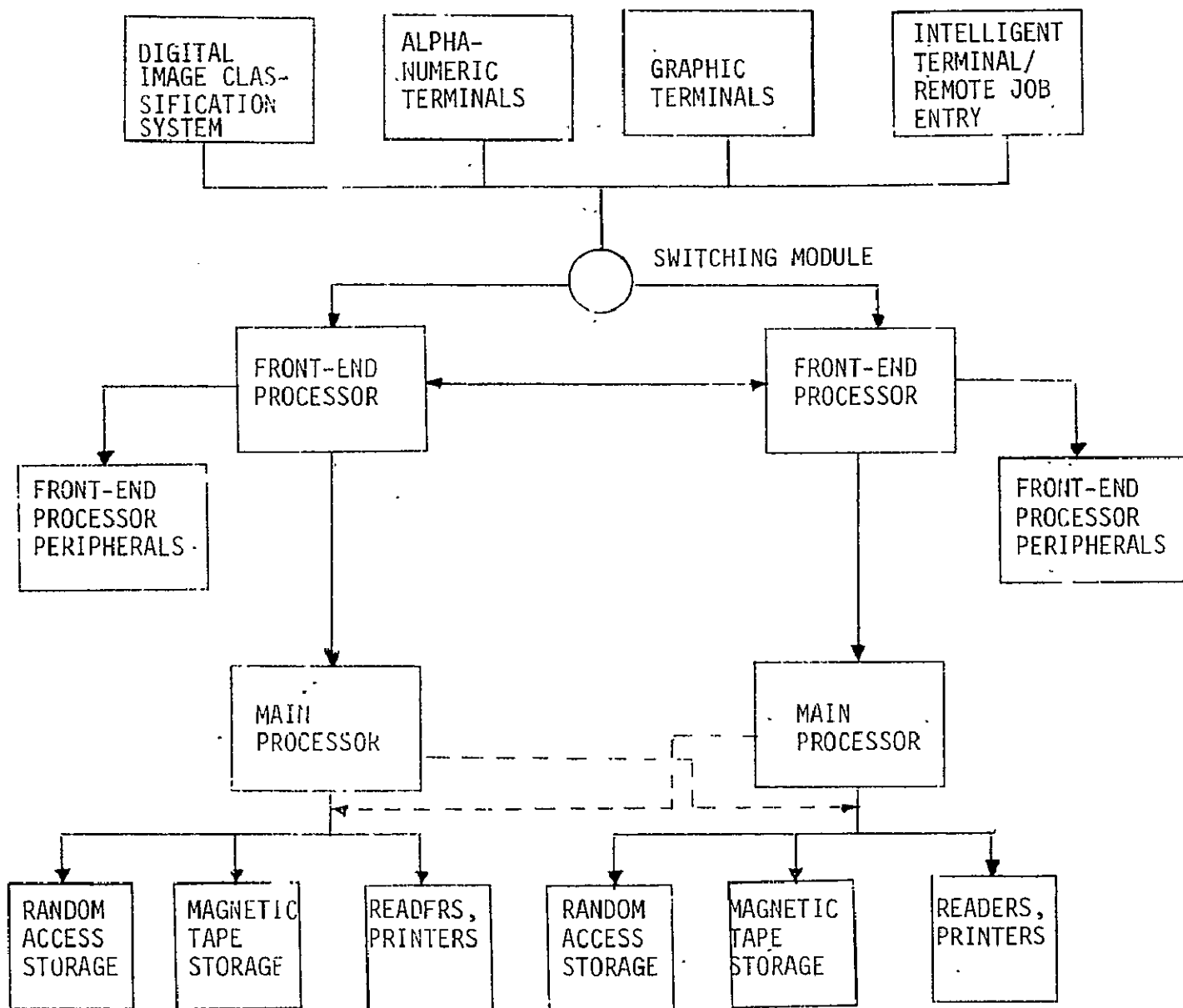
4.4.1

Introduction

After having read the previous sections on hardware and software and the operational data base concept, the interested and discerning reader will have made several important observations. One of these would be the broad terms and generalities used in describing most aspects of the operational system. This is intentional for two reasons.

USDA DEPARTMENTAL INTEGRATED SYSTEMS PROJECT
HARDWARE ARCHITECTURE CONCEPT

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----- SWITCHABLE LINES

FIGURE 4-1

First, this document is a requirement document and not a design specification; the second reason is that a concept is being addressed, not the ultimate system. The seeming redundancy between items and functions described here and currently operating systems within the various USDA agencies again must be viewed with the concept, not operating fact, in mind. A LACIE system will require ancillary data in addition to LANDSAT data and much of this reference data exists as a requirement of existing systems. The successful completion of the LACIE, and USDA's decision to implement an operational LACIE system, would indicate a logical merging of systems requiring common data with the existing systems having the added benefit of the LACIE data for use in analytical considerations. Thus, no redundancy. A last, important consideration is the Departmental Integrated Systems Project (ISP) and its relationship with LACIE. A production LACIE system and the ISP would have, in addition to the data requirements previously discussed, several common areas of interest. Among these would be hardware and software capabilities and standards, data element standardization and the wide range of applications and users levying requirements. Thus, the requirements contained in this document have more than just incidental similarities with those of the ISP. Any conversion effort to take an experimental system and create a production system in a USDA computer center would benefit greatly from a conscious effort to create systems with common requirements.

The previous sections have discussed the existing and planned USDA information handling systems and have outlined the various characteristics of these systems which must be considered in the systems design and development of the LACIE system. This section describes the essential components of a system concept for an operational LACIE system as envisioned by USDA. The system concept consists of hardware, software and data base components.

4.4.2

Hardware Design Concept

The USDA LACIE hardware design concept is essentially based upon the Departmental Integrated Systems Plan concept which calls for a multi-CPU host mainframe computer with mini-computer front-end processors to handle communications and other specialized tasks. The front-end processor and host mainframe hardware approach permits remote stand alone processing of repetitive tasks, like digital image analysis or yield modelling, as well as remote access to a large host computer data base that would be required for historical and related current crop production data.

Additionally, if the concept of a computer system with a mini-computer handling all communications to the host, as well as being used as a development medium for applications software, is followed in the LACIE design, conversion will be limited, in general, to th

modification of that software required to interface the mini-computer with the mainframe and the rebuilding of the data base to use the data base management system offered by the host computer. Figure 4-2 illustrates the hardware design concept for an operational LACIE system. Figure 4-3 lists the essential components of a standard mini-computer front-end processor and a specialized digital image processing device.

4.4.3

USDA LACIE Data Base Concept

A data base designed to support the USDA LACIE and other USDA remote sensing activities and existing systems with data requirements similar to LACIE will be an integrated logical structure. A diagram of such a data base is shown in Figure 4-4.

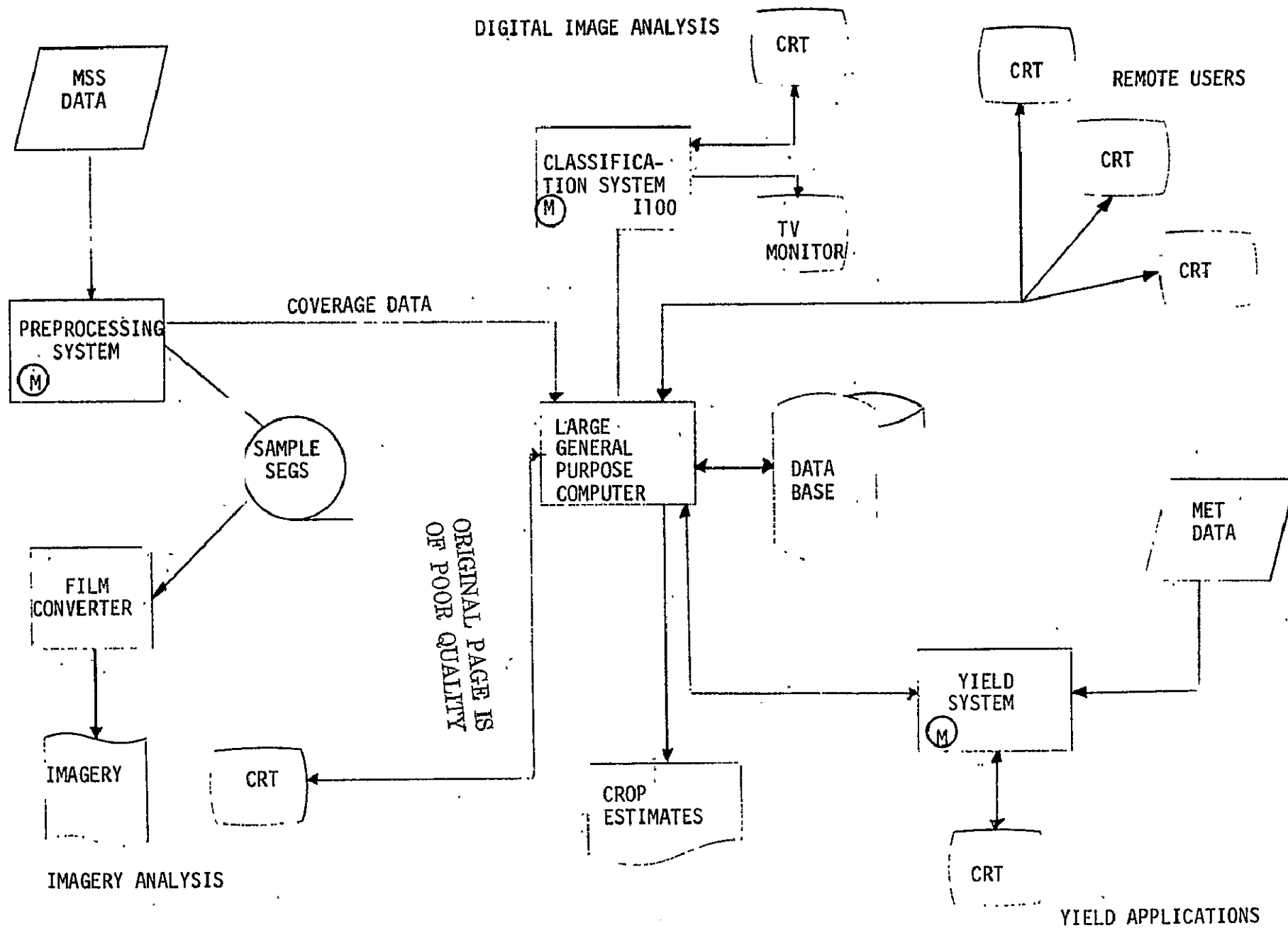
The data base would use a world geographic grid as its central theme. This coordinated grid would be related to some established cartographic base such as the Defense Mapping Agency Joint Operations Graphic chart with a scale of 1:250,000. This geographic grid technique has been successfully applied in applications using various types of remotely sensed information. The relationship between a geographic grid and an accurate cartographic product is also required by USDA analysts for selecting and relating sample segments to a known location on the earth's surface. Another reason for using a geographic grid as the central theme is that most of the meteorological data obtained by weather satellites is represented in this manner.

Each block in the diagram at Figure 4-2 represents a data base record or series of records, containing data pertinent to the title of that record. A numeric designation is provided for record identification purposes and will serve to relate the data base structure to the system software. Each of the envisioned LACIE data base records shown in the diagram is briefly discussed below.

4.4.3.1

Geographic Grid (010)

This record will contain geographic coordinate data including the latitude and longitude in degrees and minutes, of the four corners of the Joint Operations Graphic, chart number, edition, country or countries represented on the chart, and other pertinent data. The primary purpose of this record is to provide a USDA analyst with the capability to relate a sample segment, or other reference frame being analyzed, to a cartographic base. Approximately 1,000



(M) = MINI-COMPUTER

USDA LACIE HARDWARE DESIGN CONCEPT
FIGURE 4-2

Mini-computer Front-End

PDP-11/45 Central Processor w/ 32K
 Parity Core Memory
 Hardware Memory Management
 Multi-Device Autoloader
 Power/Fail Restart
 30 CPS Decwriter Terminal
 Power Supply

96K Core Memory

Floating Point Processor

Programmable Real-Time Clock

Unibus Repeater

Communications Arithmetic Unit

Moving Head Disks (2.4 million words)

On-line Disk Storage (232 million words)

9-Track Tape Units - 4

Electrostatic Printer-Plotter

Card Reader

Digital Image Processor

Multispectral Data Analysis System - Bendix

Image 100 - Multispectral Image Analysis System - GE

Mini-Computer Components

Figure 4-3

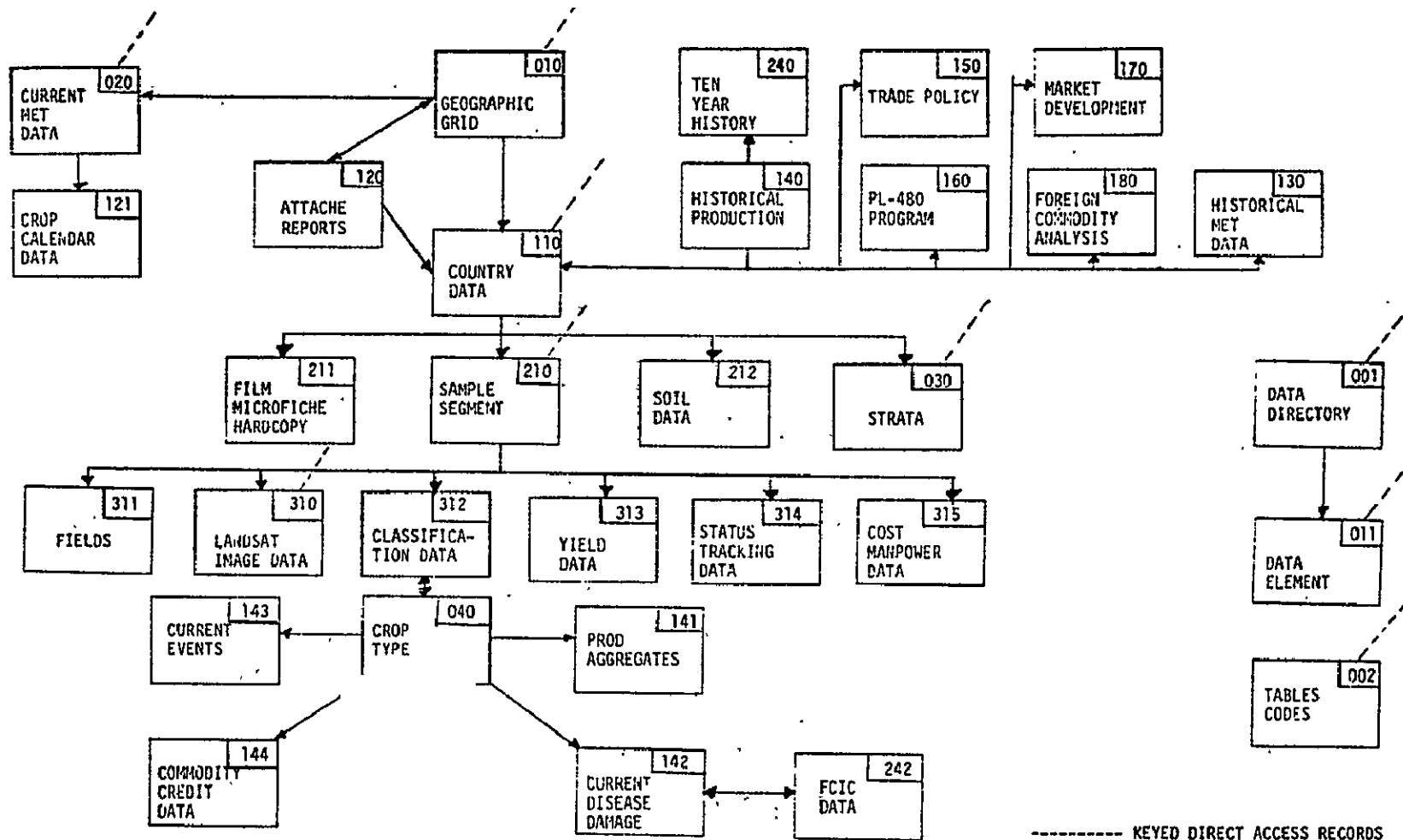


FIGURE 4-4, USDA LACIE DATA BASE CONCEPT

of these records would be required to cover the U.S. and no more than 10,000 to cover the crop growing areas of the world.

4.4.3.2

Country (110)

The country record will contain the country name, a standard country code, historical data on agricultural production at the country level, and other descriptive information. The country is the focal point for most FAS and ERS reporting and serves as a key index record for much of the remaining data. There would be approximately 150 of these records.

4.4.3.3

Segment (210)

The data in this record will describe and define the sample segment. Latitude and longitude of the site, start and stop dates of the biological windows, Goddard Space Flight Center (GSFC) magnetic tape reel number identifying the reel which contained the LANDSAT imagery for the segment in question and other indexing information. The segment is an "X" area, and its unique identification will act as an index for the analyst wishing to analyze that segment. There will be approximately 5,000 occurrences of this record.

4.4.3.4

LANDSAT Image (310)

This record will contain the imagery data and header information as received from GSFC on the LANDSAT universal format computer compatible tape (CCT). This data will not be accessed by an analyst but will be used by the classification system.

There will be approximately 5,000 occurrences of this record and will require 3 billion characters of random access storage.

4.4.3.5

Fields (311)

The record contains field definitions, such as the number of vertices, the LANDSAT frame line number, classification a priori and threshold values. The fields will be used as test, to control, areas by the analyst desiring to classify a segment or larger area. There will be a maximum of 750,000 occurrences with 250,000 representing an average.

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4.4.3.6

Classification Results (312)

This record contains the mensuration results obtained from the processing of a sample segment by the classification system. Statistical aggregation systems can merge these acreage estimates with the yield estimates giving a crop production estimate. There will be approximately 50,000 occurrences of this record.

4.4.3.7

Yield Estimates (313)

This record will contain the yield estimates resulting from the yield modeling for a given strata. These estimates will be used in conjunction with the classification results to provide crop production estimates. There will be approximately 5,000 records of this type.

4.4.3.8

Attache (120)

This record will contain data as considered significant by the FAS attaches assigned to the various countries. This data will have a subjective flavor giving the attaches' impressions and opinions as well as the information provided officially by the country's agriculture department and industry and trade documents. There will be approximately 60 records of this type.

4.4.3.9

Historical Meteorological Data (130)

This record will contain the World Meteorological Organization (WMO) site identification, location and weather parameters. The primary user of this data will be the analyst exercising the yield models. There will be a 10-year history for each of 5,000 sites (where data is available), giving a total of 50,000 records.

4.4.3.10

Historical Crop, Yield Data (140, 240)

Production figures, organized by the smallest political unit of each given country, for the last ten years will be stored in these records. Yields, acreage, and climatic data will constitute the primary data elements. Yield model users as well as

ERS, SRS, and ASCS analysts will use this data in making estimates and projections of current production. There will be approximately 2,000 records of these two types.

4.4.3.11

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International Trade Policy (150)

Data on trade agreements, restrictions, duties and current negotiations would comprise the bulk of the data in this record type. Analysts establishing policy would use this data, for example, when making determinations about large wheat sales. This data when used in conjunction with current crop estimates found in the same data base would provide a useful tool for providing quick response to policy requests. There will be a relatively small, undetermined number of records of this type.

4.4.3.12

PL-480 Program (160)

Data on programs administered by USDA under Public Law 480 will be contained in this record with foreign currency credit balances and tonnages shipped being the primary items of interest. There will be a relatively small, undetermined number of records of this type.

4.4.3.13

Market Development (170)

Strategies and policies concerning marketing of U.S. commodities as well as history of results of the implementation will be found here. This data when used with current crop estimates along with data from International Trade Policy, Foreign Commodity Analysis, and PL-480 Program records would be used to great advantage by an analyst wishing to establish new marketing plans. There will be a small, varying number of records of this type.

4.4.3.14

Foreign Commodity Analysis Results (180)

Data describing and delineating the results of a foreign commodity analysis will be found here. These data and a subjective confidence factor will be used by analysts in international trade, PL-480 and market development areas to help formulate proper positions. There will be approximately 150 records of this type.

4.4.3.15

Film, Microfilm, Microfiche, Hardcopy (211)

As the segments, or LANDSAT frames, are processed, various hardcopy items are produced. Tracking this great number of products will be nearly impossible unless an automated index and cross reference list is maintained. This record type (or series of record types if required) will contain data required to perform this function. The ASCS photo lab would provide the indexes and hardcopy items in a production environment. There will be approximately 5,000 of these records.

4.4.3.16

Current Summary Meteorological (020)

WMO station data recorded on a daily basis will be stored in this record. This data will be used primarily by analysts running the yield models for the purpose of determining the yield coefficients for use in the crop assessment procedures. There will be approximately 25,000 records of this type.

4.4.3.17

Crop Calendar (121)

Data concerning factors which influence the growth of a particular crop will be stored here. A crop identification, calendar day, growth phase, standard deviation of the phase and related data elements are typical data elements. This information will be organized by WMO station and will be used by the crop assessment, crop classification and the yield modeling processes. There will be approximately 5,000 of these records.

4.4.3.18

Strata (030)

Statistical aggregation of strata data as defined by the crop assessment analyst will be stored in this record type. These data will be used by the analyst when aggregating acreage and yield estimates to determine production. There will be approximately 12,000 of this record type.

4.4.3.19

Crop (040)

Wheat data will be the only data stored in this record type for the LACIE project. However, expansion of the LACIE concept to different crops in the future would require that the current design accommodate the new requirements. Another consideration is the user oriented thrust of the data base; even though LACIE is considering wheat only, the user currently has other crop interests and this integrated data base could handle these requirements through utilization of this record type and certain of its subordinates, primarily disease patterns, special events and production aggregates.

4.4.3.20

Production Aggregates (141)

Figures produced as a result of aggregating the acreage and yield estimates will be stored in this record. The aggregation will include spring and winter wheat and will be organized by strata (1200), zone(600), region (300) and country(8). These production figures will then be used for reporting and querying purposes to provide the analyst with crop estimate data. There will be 2,100 records of this type.

4.4.3.21

Current Crop Disease Damage Patterns (142)

As part of, or as a by-product of the LACIE, crop disease could be located and charted. Additionally, this data could be extended by an analyst as determined independently of LACIE. Knowledge of the severity and coverage of a crop disease or storm damage would aid greatly in aiding FAS, SRS and other USDA agencies in decision making. There will be a relatively small, varying number of records of this type.

4.4.3.22

Current Events (143)

Data concerning changes in cropping practices, introduction of a new crop strain or hybrid and similar other data would be stored in this record type. These data would assist an analyst in making more reliable estimates than would be possibly by using historical data alone. There will be a limited number of records of this type.

4.4.3.23

Soil (212)

Data defining soil characteristics will be stored in this record type. The yield modeling system and the crop assessment procedures will use these data in making determinations. There will be an undetermined number of these records and will depend upon the yield modeling requirements for soil classification strata and substrata.

4.4.3.24

Federal Crop Insurance Corporation Analyses (242)

As crop disease patterns and crop damages are detected and determined, quantitative and qualitative data will be stored in record type 242. This data would then be analyzed by the Federal Crop Insurance Corporation analyst and his finding would aid in projecting federal payments under the crop disaster program. There will be a small, undetermined number of this record type.

4.4.3.25

Data Element Directory (001)

This record will serve as an index, by record name or record type, to all data elements in the data base. There will be approximately 40 records of this type.

4.4.3.26

Data Element Dictionary (001)

This record will contain descriptive and definitive data and parameters concerning a data element. Such items as a short definition of the data element, the type of data, alpha or numeric, the length of the data element and the range of data values, if pertinent. This information would be of interest to analysts, design and programming staff and for technical writers and documentation people. There will be approximately 1,000 of this type of record.

4.4.3.27

Tables, Codes (002)

Any data required in codified or tabular form would be contained in this sequence of record types. This data would be used by

editing and validating applications software and by analysts as an aid in building a query interactively. Increased emphasis on data element standardization makes this capability a requirement. There will be an undetermined, small number of this record type.

4.4.3.28

Commodity Credit Corporation (144)

Data concerning the Commodity Credit Corporation's contract purchases of goods and services, Commodity Loan Program and Production adjustment will be stored in this series or records. Up-to-date crop production figures would be of great aid in planning current and future buying, selling and warehousing activities. There will be a very large, undetermined number of records of this type.

4.4.4

USDA LACIE Applications Software

The USDA crop estimating process for both foreign and domestic areas are a combination of manual and automated processes. The automated portions of the process are largely concerned with updating historical data files in the batch processing mode of a computer operation. A major portion of the actual estimation process is a mental and manual, paper and pencil, process. This manual process is analogous to computer applications software which provides an individual with a variety of manipulative and mathematical tools for analyzing available crop data.

The envisioned LACIE crop estimating process is one that will rely almost entirely on interactive computer processing of data. The data base concept, previously discussed, will contain data required to support an operational LACIE type system. Elements or modules, identical or similar to those described, will be required to support the LACIE project. Development of these modules and any associated applications software must be accomplished in such a way as to ensure maximum compatibility with present USDA computer systems. Thus, when an operational system is determined feasible, benefits other than just more timely and accurate data will be realized. By following this development approach, much of the applications software and machinable data can be rapidly transferred into the existing USDA environment at minimal cost. To achieve this, all applications software must satisfy those standards previously addressed in Section 4.3.

4.4.4.1

Applications

Applications software supporting an operational crop estimating system designed to support various agencies within USDA must fulfill diverse user applications. USDA user applications include those previously described in early portions of this document. Some examples of user applications, possible through the development of applications software, are described below.

- a. The foreign commodity analyst in FAS, supported by an operational LACIE system with remote computer terminals, will have a capability to access production data for a specific commodity and be able to compare present data base information against incoming Attache reports or meteorological data. Based on this information, the analyst may decide to change certain estimates or call up a yield model, input the most current data and execute the model. The results would be analyzed and possibly used to revise estimates.
- b. The market development analyst, through terminal access to the LACIE data base, can observe changes in foreign production which may be indicators for increased or decreased promotion of U.S. products.
- c. The country analyst in ERS, supported by the LACIE data base, can conduct economic assessments of a country's agricultural production. The analyst at report time can call upon a specific applications program to extract the most current data base information and output a copy of the data which can then be published.
- d. The operational LACIE system will also enable various USDA analysts to aggregate area and yield data derived from remote sensing and yield model functions and create production estimates.

4.4.5

Front-End Processor Software

In addition to developing specific applications software, it will be necessary to develop front-end processor software. This software will permit interaction between the user and the LACIE data base. Essential software required for the front-end processor is outlined below.

- a. Basic Operating System (Executive). This software controls the operation of the processor. It must be a modular,

disk-based, real-time operating system capable of handling multiple user tasks in a multiprogramming and hardware protected environment. It would support handlers for disks, tapes, line printers, terminals, etc. Component features include:

- Scheduling and operator commands
- Fast response time
- Memory management
- Task protection
- System disk independence
- System modularity
- File management facilities

b. Support Facilities. The support facilities software provides a capability for generating user applications software. Support facility software would include:

- Display processing
- Multi-terminal control
- File processing
- Higher order language interface
- Application program keyword control
- Remote job entry
- System monitor

c. Network Support. The network facility provides the necessary telecommunications interface software between the front-end processor and the host computer and the user terminals. Capabilities would include:

- Communications line control
- Network message switching
- Message store and forward processing
- Network protocol
- Automatic power failure restart
- Host interface
- Timing and data transfer control

SECTION 5.0
COST FACTORS

Cost factors, which addresses the cost criteria to be used by USDA in analyzing the costs and benefits of LACIE, will be provided at a to be determined date.

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